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Staging and Decisional Balance Measures for Two Diabetes Self-Management Behaviors

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STAGING AND DECISIONAL BALANCE MEASURES FOR TWO DIABETES SELF-MANAGEMENT BEHAVIORS

BY

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Abstract

Recent research shows proper performance of self-care regimens helps postpone development, slow progression, and alleviate symptoms of the many complications of diabetes mellitus. The Transtheoretical Model (TTM) is a systematic approach to the acquisition of health behaviors, showing remarkable success across a wide range of behaviors.

A total of 2056 participants with Insulin Dependent Diabetes Mellitus and Non-Insulin Dependent Diabetes Mellitus were proactively recruited, and assessed regarding their typical performance of glucose testing and medication adherence. The two constructs of the TTM that were investigated were Stage of Change and Decisional Balance. For both behaviors, measure development followed the same procedure. When a Principal Component Analysis requesting two factors resulted in all decisional balance items loading on their theoretically appropriate constructs, the theoretical two-factor correlated structure was imposed on an exploratory sample. The fit indices for this model were excellent and the proposed model explained significantly more than even the next best alternative model. This model was then imposed on a confirmatory sample and a series of subsamples, and, again, fared quite well.

With high proportions of participants in the Action and Maintenance stages of both behaviors, participants were reassigned to stage. Similarity of the single- and four-item algorithms shows the algorithms are internally consistent, while the cross validations by related variables provide external validity. Two-way Multivariate Anayses of Variance were performed on decisional balance for both behaviors, one by stage and gender, and the other by stage and type of diabetes. For glucose testing, neither interaction was

significant, but all three of the main effects were. For medication, neither the interaction of stage by gender nor the main effect for gender were significant, however, the main effect for stage and the interaction of stage by type were.

As can be seen, staging and decisional balance constructs of the TTM hold up in one area of chronic disease behavior management--diabetes self-management. Before developing interventions, however, measures for the other constructs of the TTM need to be developed. This study is only the first of many steps needed to develop an effective, efficient intervention.

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While I hope each person knows the things I've said here, too often the "obvious" things go unacknowledged, and it is then that we end up wishing we had said them.

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Prevalence and Incidence of Diabetes

Diabetes mellitus is a heterogeneous family of chronic systemic diseases whose one common feature is the body's inability to properly metabolize sugar. This inability is the result of the decreased secretion or activity of insulin. Its statistics are staggering. Diabetes is the third leading cause of death by disease in the United States, preceded only by heart disease and cancer (Cox, Gonder-Frederick, Pohl, & Pennebaker, 1986; Ignatavicius & Bayne, 1991), and it is the leading cause of blindness, lower extremity amputations, and kidney transplants in the United States (Cox & Gonder-Frederick, 1992). According to the American Diabetes Association (ADA, 1993), approximately 5% of Western populations are affected with diabetes, which means that there is an estimated total of 13 million Americans who have diabetes--over half of whom are not even aware that they have the disease. Annually, more than 650,000 people are diagnosed with diabetes, and more than 150,000 people die from it. Its treatment costs over $90 billion per year in both direct costs (such as payment for health care services rendered) and indirect costs (such as decreased productivity and disability).

Furthermore, the prevalence, incidence, and mortality rates of diabetes reflect a bias towards older people, women, and minorities. Both incidence (number of new cases each year) and overall prevalence (total number of current cases) increases with age across races, but minorities are consistently higher. For example, prevalence increases with age until finally, in the 65-74 year old age bracket, it reaches 17% of whites, 26% of African-Americans, and 33% of Hispanics. Although incidence is decreasing for women and increasing for men, it is still higher among women (ADA, 1993).

The two most common types of diabetes mellitus are insulin dependent diabetes mellitus (IDDM) or Type I diabetes and non-insulin dependent diabetes mellitus (NIDDM) or Type II diabetes. IDDM is usually diagnosed early in life--before age 30, but primarily during childhood--and people with IDDM need exogenous insulin to survive. NIDDM is usually diagnosed later in life--after age 30--and people with NIDDM have a much more varied regimen. Some people with NIDDM can use just diet and exercise to control their glucose levels, others use hypoglycemic oral medication, and others need exogenous insulin.

Sometimes NIDDM can start, and continue undiagnosed for quite a while. Unfortunately, undiagnosed NIDDM is not a benign condition. According to Harris et al. (Harris, Klein, Welborne, & Knuiman, 1992), untreated hyperglycemia is a major risk factor for retinopathy, renal impairment, and sensory neuropathy. These complications both begin and progress prior to the diagnosis of NIDDM. Among newly diagnosed NIDDM patients, macrovascular complications are two to three times more common than in people with normal glucose tolerance (Harris, et al., 1992). In general, people with diabetes are two to four times more likely to die from cardiovascular disease and are at least four times more likely to have peripheral vascular disease than people without diabetes (ADA, 1993).

Comorbidities and Predictors of Onset

Family history of diabetes, obesity, poor dietary intake, lack of exercise, high glucose levels, and even low education levels, low income, and urbanization (which usually is associated with changes in diet, physical exercise, and socioeconomic status) all predict the development of diabetes (ADA, 1993; Zinman, 1984; Zinman & Vranic, 1985).

Estimates of the percentage of all people with diabetes who have NIDDM vary between 80% and 95%, of which 60% to 90% are obese (Cox & Gonder-Frederick, 1992; Hampson, Glasgow, & Toobert, 1990). In addition to predicting the onset of diabetes, obesity is also associated with insulin resistance, and exacerbates the risk of cardiovascular disease (Abrams, Steinberg, Follick, & Raciti, 1986).

Complications

As was previously stated, the degree of complications and the rate at which they develop are related to control of glucose levels (DCCT, 1993; Ignatavicius & Bayne, 1991). Unfortunately, even with strict adherence to medication, glucose testing, diet, and exercise behaviors, glucose levels still fluctuate excessively, and complications eventually arise (Cox & Gonder-Frederick, 1992). Complications include: retinopathy, neuropathy, nephropathy, and both peripheral (micro-) and coronary (macro-) vascular disease (both of which occur at accelerated rates; Cox & Gonder-Frederick, 1992; Ignatavicius & Bayne, 1991; Rossini, Mordes, & Like, 1985). Onset of these complications is not usually predictable, but some of them can be treated (Knuiman, Welborne, McCann, Stanton, & Constable, 1986). Many studies have been conducted in order to find correlates of diabetic complications. The results of these studies indicate both good and bad news.

The good news is that some of the correlates can be controlled. For instance, the Diabetes Control and Complications Trial (DCCT, 1993) followed 1441 patients for an average of 6.5 years. After being randomly assigned to either the intensive (i.e., frequent testing of blood glucose, adjusting insulin doses according to glucose levels, more frequent contact with physicians) or conventional treatment regimens, the results showed that those in the more intensive treatment regimen had a lower cumulative incidence of all

of these complications than those in the conventional regimen. This was a phenomenal finding. Although for many years this was thought to be true, the DCCT was the first experimental trial to show it. Some of these group differences, however, did not appear until rather late in the study (i.e., after three to five years of treatment) and even then, they only appeared after strict adherence to the regimen for this lengthy period of time. Furthermore, as may be indicated by their adherence levels alone, this study was composed of a very specialized sample of people with diabetes, thus its generalizability may be quite limited. Generalizability issues not withstanding, the potential control of and reduction in complications via behavioral change opens up a whole new arena for psychological interventions in the medical world.

The bad news regarding complication correlates is that some of them cannot be controlled. For instance, using both IDDM and NIDDM patients, Knuiman et al. (1986) found that age, duration of diabetes, and age at diagnosis are the best time-related correlates of diabetic complications. Interestingly, neither complication occurrence rates nor risk-factor profiles differed between IDDM and NIDDM patients, suggesting that interventions (such as those used in the DCCT) may be able to be applied across different types of diabetes.

Diabetes Self-Management Behaviors

Upon diagnosis, people with diabetes must make major life-style changes (Curry, Kristal, & Bowen, 1993; Hampson, et al., 1990). These changes include the performance of many self-care behaviors, which puts a tremendous burden on the patient (Cox, et al., 1986; Surwit, Fenglos, & Scovern, 1983). Regimen behaviors include the administration of medication, testing and recording of blood or urine glucose levels, modification of

dietary intake, adoption of physical activity, performance of routine foot care procedures, management of weight, attendance of regular eye examinations, reduction of stress, and cessation of smoking habits (Clark & Abrams, 1993; Cox & Gonder-Frederick, 1992; Curry, 1993; Galvotti & Fava, 1993; Heiby, Gafarian, & McCann, 1989). Obviously, these behaviors make the treatment of diabetes very complex and intense (Hampson, et al., 1990). The behaviors themselves are extensive, continuous, tedious, expensive, and (sometimes) even aversive (Cox, et al., 1986). The daily performance of these behaviors is no small task and is particularly difficult to do on a regular basis.

Medication. Insulin plays a crucial role in the body's ability to metabolize glucose, free fatty acids, and amino acids. Perhaps most importantly, insulin enables cells to absorb glucose, which is a major source of energy (Ignatavicius & Bayne, 1991). Using medication, inadequate amounts of insulin can be compensated for in two different ways. First, insulin can be injected into one's body, which, as was previously stated, is the method the IDDM patients must use, and the method that some NIDDM patients use. Second, oral hypoglycemic medications can be taken, which stimulate one's pancreas to produce more insulin of its own and decrease insulin resistance, which is the method that other NIDDM patients use.

Of all people who have diabetes, there are 27% who use insulin, 35% who use oral diabetes medications, 14% who use only diet, and, disturbingly, there are actually *24%* who use none of these therapies. These types of therapy vary by age, with the younger and middle-aged age groups being more likely to use insulin, and the older age groups being more likely to use oral agents and diets. In addition, these treatments also vary by

race, with insulin being used more frequently among African-Americans, and Hispanics being the most likely to be untreated, (ADA, 1993).

Without adequate amounts of insulin, the level of glucose in the blood rises above the target range. High levels of glucose in the blood is known as hyperglycemia. Conversely, with excessive amounts of insulin, the level of glucose in the blood falls below the target range. Low levels of glucose in the blood is known as hypoglycemia. In both cases, side effects can range from quite mild ones, such as headaches and irritability, to ones as severe as coma and even death (Ignatavicius & Bayne, 1991).

Adherence rates for long-term treatment regimens in general are quite poor--between 41% and 69% with a mean of 54% (Sacket & Snow, 1979). Granted that there are problems with defining "adherence" and that there are likely to be differences in adherence rates between problem areas (as a function of regimen complexity, patient population, etc.), even so, these rates are quite discouraging. Fortunately, adherence rates for diabetes treatment regimens tend to be better (Glasgow, McCaul, & Schafer, 1987; Glasgow, Toobert, Hampson, Brown, Dewinsohn, & Donnely, 1992). For example, according to Glasgow et al., (1987), among people with IDDM, 92% have never missed an injection, and 77% take their injections within 30 minutes of the prescribed time or activity.

Glucose testing. Glucose self-monitoring (using either blood or urine) is an important diabetes self-management behavior because it enables the patients to keep their glucose levels within their target ranges, and to prevent episodes of hypo- or hyperglycemia. We know from the DCCT (1993), that tighter control of glucose levels (medicating and testing more frequently, and following a diet and an exercise plan)

reduces both the incidence and the progression of the complications associated with diabetes. However, it is not the performance of glucose monitoring, in and of itself, that leads to better diabetes self-management (Baumann & Dougherty, 1988). Glucose monitoring simply leads to the ability to better control one's glucose levels. It is how one utilizes the glucose monitoring information to control glucose levels that leads to better diabetes self-management, which is the key to delaying the onset of complications (Ignatavicius & Bayne, 1991).

Estimates of the percentage of people who test their blood glucose at least once a day vary from 33% to 50% (ADA, 1993; Ignatavicius & Bayne, 1991). Broken down by type of diabetes: 79% of IDDM patients test their glucose at least once a day, 53% of insulin-using NIDDM patients test their glucose at least once a day, and 24% of non-insulin using NIDDM patients test their glucose at least once a day (Ignatavicius & Bayne, 1991).

When looking at the performance of any testing at all over the course of a week, the percentages are relatively high. They range from 83% to 88% (Gonder-Frederick, Jullian, Cox, Clark, & Carter, 1988; Hirsch, Matthews, Rawlings, Breyfogle, Simonds, & Kossoyu, 1983; Wing, Epstein, Nowalk, Scott, & Koeske, 1985). However, this is the percentage of people who are measuring their glucose levels at all and is NOT to be interpreted as being the percentage of people who test their glucose levels with the same frequency as they were instructed by their physician. Moreover, these frequencies were based on self-reported data, which is known to overestimate actual frequencies (self-report or subject-response bias; Wing, et al., 1985). When measuring the percentage of people who are performing glucose testing with the same frequency as they were

instructed by their physician, studies report adherence rates of 32% to 68% (Gonder-Frederick, et al., 1988; Wing, et al., 1985). These frequencies include both self-reported and marked item studies.

Factors Affecting Diabetes Self-Management

Treatment and disease variables. Adherence to medical regimens is a very complex phenomenon. It is a function of many factors and, as such, is not easily predicted. Some treatment related factors that impede adherence to diabetic regimens include behavioral restriction (i.e., lifestyle change), length of treatment durations (i.e., one's entire remaining lifetime), frequency of behavior performance (i.e., up to several times daily), and delayed effects of non-adherence (i.e., up to several years later; Rainwater, 1983). Adherence also reportedly varies with the degree to which normal functioning is interrupted, and the degree to which the doctor and the patient agree on the prescribed regimen (Eckerling & Kohrs, 1984).

Sociodemographic variables. Perhaps as may be expected, people who have more years of education adhere more closely to their prescribed regimens than people with fewer years of education (Polly, 1992). Interestingly, however, women have a higher knowledge about diabetes than men (McCaul, Glasgow, & Schafer, 1987), while men have a higher overall adherence than women (Littlefield, Daneman, Craven, Murry, Rodin, & Rydall, 1992).

Intrapersonal variables. Adherence to prescribed regimen behaviors reportedly varies with such cognitive variables as perceived health, perceived barriers, and self-efficacy (Irvine, 1989; Kavanagh, Gooley, & Wilson, 1993; Littlefield, et al., 1992; Padgett, 1991; Polly, 1992). Littlefield, et al. (1992) found that low self-esteem, low self-

efficacy, high depression, and high rates of binge eating behavior were all associated with lower adherence. The same relationship between self-efficacy and adherence was found by Padgett (1991) and was found specific to glucose testing and medication adherence by McCaul et al. (1987). However, neither a high correlation nor a low correlation is consistently found between personality variables and adherence to medical regimens, therefore, personality variables cannot be said to either be related or not be related to adherence to medical regimens (Cox & Gonder-Frederick, 1992; Cox, et al., 1986).

Furthermore, there seem to be some very interesting relationships between the attitudes and beliefs of people with diabetes and their regimens (Irvine, 1989). People who accept their diabetes (and, therefore, are less anxious about it) may obtain better control by adhering more closely to their prescribed regimens (Cox, et al., 1986). In addition, people on insulin-dependent regimens report less positive attitudes towards living with diabetes than those patients on diet-only regimens, and lower levels of perceived health than those patients on oral medication regimens. Thus, perceived health seems to correlate with adherence to multiple behaviors. Those patients who are on insulin-dependent regimens seem to have poor attitudes about living with diabetes and poor perceived health. Consequently, those patients who are on insulin-dependent regimens may be at particularly high risk for complications due to non-adherence.

The Transtheoretical Model of Behavior Change

As is evident, the day to day life of people with diabetes differs dramatically from that of people without diabetes. Numerous cognitive and behavioral changes are necessary for the successful management of diabetes and for the prevention of its complications. Adherence to medication regimens, regular testing of blood glucose levels,

modification of diet, and participation in regular physical activity or exercise are consistently cited as the most important behavioral changes in the self-care of people with diabetes (Cox & Gonder-Frederick, 1992; Heiby, et al., 1989; Rainwater, 1983). As things stand, ". . . levels of self-care [are] inadequate for the maintenance of adequate metabolic control and the prevention of long term complications" (Irvine, 1989, p.10). It is hypothesized, however, that by implementing disease prevention and health promotion strategies, we can eliminate more than 50% of its disabling complications (Sulivan, 1991).

According to Kumanyika & Ewart (Kumanyika & Ewart, 1990), model based strategies of behavioral change may be underutilized in the diabetes population. Thus, there is a pressing need for the development and application of theoretical models, measures, and methods of health behavior change in people with diabetes.

Systematic strategies for behavioral change can only be developed on the basis of corresponding models of behavior change. One of the most promising models of health behavior change is the Transtheoretical Model (TTM; DiClemente & Prochaska, 1982; Prochaska & DiClemente, 1983; Prochaska & DiClemente, 1992). Over its 15 years of theoretical and research development, common principles of change have been found that can account for how people succeed and fail in their attempts to modify problem behaviors. The TTM describes relationships among several concepts.

Stages. The Stages of Change describe a developmental sequence of motivational readiness to modify problem behaviors. This sequence is composed of five stages through which people pass (Prochaska, DiClemente, & Norcross, 1992a). Precontemplation (PC) is when a person has no intention to change in the foreseeable future (usually defined as: the next six months). Contemplation (C) is when someone is seriously considering

changing in the foreseeable future. Preparation (P) involves two components: intention to change and a behavioral attempt to change. The time-frame for intention to change is within the next month, and the behavioral attempt to change must be in the recent past. Action (A) is when a person has been performing the new behavior for less than six months. Finally, Maintenance (M) is when a person has maintained the new behavior for six months or more. Movement through the stages is rarely linear (Prochaska & Goldstein, 1991; Prochaska, Rossi, & Wilcox, 1991; Prochaska, Velicer, Guadagnoli, Rossi, & DiClemente, 1991). People often relapse, recycling back to an earlier stage of change. In fact, successful behavior change may require several attempts before long-term maintenance is achieved (Prochaska, et al., 1992a; Prochaska, DiClemente, & Norcross, 1992b).

Processes. The strategies for progressing through the Stages of Change are ten processes of change. The processes of change are different strategies that people use in their attempts to change. Each of the processes tends to be used more or less, depending upon one's stage of change. Successful change is characterized by a specific pattern of process use (DiClemente, Prochaska, Fairhurst, Velicer, Velasquez, & Rossi, 1991; Prochaska & DiClemente, 1983). The processes can be viewed as belonging to one of two categories: experiential or behavioral (Kristeller, Rossi, Ockene, Goldberg, & Prochaska, 1992; Prochaska, Velicer, DiClemente, & Fava, 1988; Rossi, 1992). Experiential processes tend to be used more in the earlier Stages of Change. These processes include: consciousness raising, dramatic relief, social liberation, environmental reevaluation, and self-reevaluation. Behavioral processes tend to be used more in the later Stages of Change. These processes include: reinforcement management, stimulus control,

counter conditioning, helping relationships, and self-liberation (Prochaska & Goldstein, 1991).

Decisional balance. One intervening variable is decisional balance. Decisional balance involves the weighing of the pros and cons of changing one's behavior. Originally, decisional balance items were created based on Janis & Mann's decision making model (Janis & Mann, 1977), which is a conflict model. It asserts that all relevant considerations can be sorted into eight main categories: utilitarian gains or losses for oneself, utilitarian gains or losses for significant others, self-approval or self-disapproval, and approval or disapproval from significant others. However, principal components analysis consistently indicates that these items are best summarized by two scales: the pros of changing and the cons of changing (Velicer, DiClemente, Prochaska, & Brandenburg, 1985).

Across many behaviors, the pros of changing have regularly been found to increase across the Stages of Change; while the cons of changing decrease across the Stages of Change, thus it has been termed the cross-over pattern of Decisional Balance (Prochaska & Goldstein, 1991; Prochaska, Velicer, Rossi, Goldstein, Marcus, Rakowski, et al., 1994). In addition, it has been found to take one full standard deviation of change on the pros (i.e., increase), while it only takes one half of a standard deviation of change on the cons (i.e., decrease) in order to move from Precontemplation to Action (Prochaska, 1994). These are the "strong" and "weak" principles of change, respectively.

Self-efficacy. Another intervening variable in the TTM model is Self-Efficacy. Bandura (1977) originally formulated the concept of self-efficacy, positing that a person's perceived ability to perform a behavior is highly related to his/her actual ability to perform that behavior. In fact, self-efficacy and future performance have been found to be more

closely related than past behavior and future performance (Bandura, Adams, Hardy, & Howells, 1980; DiClemente, 1981). Self-efficacy can be evaluated across various situations in which maintaining new behaviors may be difficult. In the TTM, these situations are typically characterized as being individual, social, and physiological in nature, and are called negative/affective, positive/social, and habit/addictive, respectively (Velicer, DiClemente, Rossi, & Prochaska, 1990). In addition to evaluating the temptation to no longer perform new, healthy behaviors, confidence to continue performing new healthy behaviors may also be evaluated in those same situations (Velicer, et al., 1990). These two subscales (Tempting Situations and Confidence) compose the Self-Efficacy construct of the TTM model.

As with the pros and cons of the decisional balance construct, the temptations and confidence of the self-efficacy construct also show the cross-over pattern across the Stages of Change. Using cross-sectional data, as stage increases, temptation decreases, while confidence increases, both in a linear fashion (Prochaska, et al., 1991).

Application and success. Across several problem areas, these variables have consistently outperformed demographic and personal history variables in their ability to predict both successful change and relapse (DiClemente, et al., 1991; Marcus, Rossi, Selby, Niaura, & Abrams, 1992b; Prochaska & DiClemente, 1985; Prochaska, et al., 1992a; Prochaska & Goldstein, 1991; Redding, 1993; Wilcox, Prochaska, Velicer, & DiClemente, 1985). As outlined by Prochaska et al. (1994), the TTM has been successfully applied across a broad range of problem behaviors. The Stages of Change and Decisional Balance constructs of the TTM were supported in twelve separate studies, on twelve different problem behaviors (Prochaska, et al., 1994). These problem behaviors

were: smoking (Velicer, et al., 1985); quitting cocaine (Rosenbloom, 1991); weight control (O'Connell & Velicer, 1988); high fat diets (Rossi, 1993); adolescent delinquent behaviors (Fiore-Lerner, 1990); safer sex (Redding, Rossi, Velicer, & Prochaska, 1989); condom use (Prochaska, Harlow, Redding, Snow, Rossi, Velicer, et al., 1992); sun exposure (Rossi & Blais, 1991); radon exposure (Rossi, 1990); sedentary lifestyles (Marcus, Rakowski, & Rossi, 1992a); mammography screening (Rakowski, Dube, Marcus, Prochaska, Velicer, & Abrams, 1992); and physicians' preventive practices with smoking (Eaton, Goldstein, Guadagnoli, Niaura, McDonald, & Dube, 1992). Given the tremendous need for behavioral change in people with diabetes, the need for model based research on behavioral change, and the broad range of behaviors with which the TTM of behavior change has been successful, diabetes seems to be a natural target for its application. In fact, this need has been recognized by the diabetes professional community, and a special issue of Diabetes Spectrum was devoted to its application (Ruggiero & Prochaska, 1993).

Method

Participants

The project was part of a larger study (Ruggiero, Dryfoos, Prochaska, Rossi, Rossi, Greene, et al., 1996), which was done in collaboration with Johnson & Johnson. Participants with IDDM as well as those with NIDDM were recruited, and assessed regarding their typical performance of many behaviors, the two currently of interest being self-monitoring of glucose level and medication adherence. The recruited sample consisted of 2800 people with diabetes, 1300 of whom were representative of the U.S. diabetes population, as well as an additional 1500 insulin-using participants, who were

included in order to increase our sample of Type I participants (in particular). Due to the low expected response rate of approximately 58%, a post-card prompt was planned, however, the actual response rate was 73.4% resulting in a total of 2056 participants, hence, the post-card prompt was not executed. There were roughly equal numbers of participants obtained from the representative (n=988) and augmented (n=1068) samples; the distribution of type of diabetes among each subsample varied accordingly (see Table 1).

The sample was an older one (M=59.1, SD=14.1) with many retired people (43.9%). Most were females (61.8%), married (62.0%), and fairly well educated (46.8% had at least some college). While the sample was largely Caucasian (69.9%) there was an unusually high representation of Native Americans (23.0%; see Table 2).

Type of diabetes will be broken down into Type I (those diagnosed below age 30 and have taken insulin since diagnosis), Type II using insulin (those diagnosed at or above age 30 and are currently using insulin), and Type II not using insulin (those diagnosed at or above age 30, are not currently using insulin but may or may not be taking pills). Participants with type I diabetes constituted 13.8% of the sample, participants with type II diabetes who were using insulin constituted 55.9% of the sample, and participants with type II diabetes who were not using insulin constituted 30.2% of the sample. There was 8.8% of the sample who who could not be typed (10.4% of the representative sample and 7.3% of the augmented sample). Less than 20% of the sample had heard of the DCCT and were aware of its results. When looked at by type of diabetes, it was a disappointing number of those with type I diabetes (35.7%) who were aware of the DCCT results. The percentages, however, were in the expected direction, with less of those with type II

diabetes using insulin who were aware of the results (19.9%), and even fewer of those with type II diabetes *not* using insulin who were aware of the results (10.6%; see Table 2).

The distribution of staging for all behaviors was severely skewed, with the vast majority of participants indicating they were in Maintenance (based on the one-item algorithms, the range was from 73.4% to 94.7%; see Table 3). Regarding general health status, overall, the sample was in relatively good health. When looking at potential complications of diabetes, both individually and using a composite variable, the majority of participants do not have problems: over 50% of the participants answer "no" to each listed complication, and the mean number of complications (out of a total of 16) was 3.8 (SD=2.7). As far as hospital and emergency room admissions, routine office visits, and days of work missed due to diabetes problems, all of these were severely skewed and kurtotic. Only 10.4% of the sample had been admitted to the hospital within the last year, of those admitted the mean number of admissions was 2.2 (SD=5.6), and the mode and median were only 1. The mean length of stay for these admissions was 10.4 days (SD=13.2), however, the mode was only 3 days and the median was 6 days. There were 14.3% of the participants who had emergency visits, among whom the mean number of visits was 2.6 (SD=3.1), the mode was 1 visit, and the median was 2 visits. Almost 90% of the participants visited their doctors for routine exams within the last year, the mean was semi-annually (M=5.8, SD=7.0), but both the mode and median were quarterly (4 times in the last year). Finally of those who were employed part- or full-time, 16.4% missed any work at all, the mean indicated that when they missed any they missed quite a bit, (M=9.3, SD=20.5), but the mode was only 2 days and the median was 3 days (see

Table 4). For frequencies of health status variables specific to each behavior (such as recommended regimens, skipping, behavior in the last week, etc.), see Tables 5-7.

Using listwise deletion, there were 1186 participants with complete decisional balance data for all glucose testing items (number of items=26), and 1573 participants with complete decisional balance data for all medication items (number of items=18). When considering those who have complete decisional balance data for the final measures (number of items=12) and who also have stage for these behaviors, there are 1282 participants for glucose testing and 1495 participants for medication.

Measures

Typical demographic items were collected along with some descriptive diabetes characteristics (both general and behavior-specific).

Staging. Two different methods were used in this study to assess stage of change for adherence to both self-monitoring of glucose testing and medication regimens. Adherence to medication regimens was broken down into adherence to pill regimens and adherence to insulin regimens. First, there was a series of four dichotomous items. Second, there was a single item with five stage-appropriate alternatives.

Decisional balance. Decisional balance items measure the importance of each opinion (item) to the participants in their decision to perform each behavior. Items were rated on a five-point Likert scale, where 1 = "Not At All Important" and 5 = "Extremely Important." Thus, lower scale scores indicate little importance of that scale to the participants' decision making process and higher scale scores indicate more importance of that scale. There are 26 decisional balance items for glucose testing, 14 are pros and 12

are cons. There are 18 decisional balance items for medication, nine are pros, and nine are cons.

Procedure

Items were generated, randomized, given to confederates who were knowledgeable about the TTM model, and these people were asked to sort the items into the categories they believed the items represented. Any ambiguous items, such as those items that multiple confederates sort into incorrect categories, were then discarded. Items, sorted incorrectly by only one person, or sorted correctly but were difficult to understand, were then edited. Some new items were then created.

Participants were proactively recruited by mailing them packages including both a letter about the study and the study questionnaire. There was only one point of contact for each subject, after which the subject's participation in this study was complete. As incentives for completing the questionnaire, there were 16 drawings for cash prizes--three drawings for prizes of $150 each, five drawings for prizes of $100 each, and eight drawings for prizes of $50 each.

The measure development process included a series of Principal Components Analyses (PCA) and Confirmatory Factor Analyses (CFA). First, a PCA was performed on an exploratory sample and the number of components to be retained was determined using both Velicer's (Velicer, 1976) Minimum Average Partial correlation (MAP) procedure, and Horn's (Horn, 1965) Parallel Analysis (PA) procedure, both of which have been well supported in the literature (Zwick & Velicer, 1986). No items were deleted based solely on the PCA. Next, several CFAs were performed on the exploratory sample in order to determine which model best fit the data. Then, the best model was applied

(using CFA) to the second half of the sample--the confirmatory half. Last of all, this model was applied to various sub-samples (using CFA) as validation for the measure's application to these sub-samples.

Crosstabs of the two staging algorithms for each of the three behaviors indicated how well they matched (i.e., to what extent they indicated the same stages for the same people). Crosstabs of stage with related variables, for example, how many times participants skipped each behavior, provided some validity for staging.

Next, Discriminant Functions Analyses (DFAs) were done in order to determine how well stage could be predicted from decisional balance. Finally, Multivariate Analyses of Variance (MANOVAs) were done in order to determine whether or not there were differences across the stages on decisional balance; univariate Analyses of Variance (ANOVAs) and Tukey tests were used as follow-up tests to the MANOVAs.

Except for the PCAs, which were done using Component Analysis Extended (CAX; Velicer, Fava, Zwick, & Harrop, 1988), all statistics were done using SPSS, version 4.0 (1990); the CFAs used the LISREL program, version 7.16; the crosstabs used the CROSSTAB program; the DFAs used the DISCRIMINANT program; the MANOVAs used the MANOVA program; and the ANOVAs used the ONEWAY program with the subcommand TUKEY to obtain the Tukey tests.

Results

Glucose Testing

The sample of 1186 participants with complete glucose testing decisional balance data was randomly split into exploratory and confirmatory subsamples of n=579 and n=607, respectively.

Glucose Testing Decisional Balance Measure Development

Principal Components Analysis (PCA). Using the exploratory subsample and listwise deletion, a 26x26 matrix of interitem correlations was created (n=579). PCA was then conducted using CAX. MAP suggested a four component solution (accounting for 60.1% of the variance), while PA suggested a three component solution (accounting for 56.1% of the variance). The third component, suggested by both MAP and PA, was composed of three items that seemed to be related to one's health care provider. The fourth component, suggested by MAP, was composed of only two items that were both related to exercise. The requested two factor solution resulted in all items loading on their theoretically appropriate constructs, most items loaded well (.554-.876 and .381-.726), and this solution accounted for 49.4% of the variance. Using an oblique rotation, the two factors had a correlation of .119.

Confirmatory Factor Analyses (CFA): The Two Factor Correlated Model. Given that the requested two-factor PCA solution resulted in all of the items loading appropriately, an attempt was made to *impose* the theoretical two-factor correlated structure on the exploratory sample. Several iterations of models were performed, deleting items at each step with any of the following characteristics: loading less than .50 on their appropriate factor, loading .30 or higher on both factors, or items that had extremely high

modification indices. The final measure consisted of six Pros of glucose testing and six Cons of glucose testing. The fit indices for this model were: 1) $\chi^2_{(53)}$=157.57, p <.001; 2) Goodness of Fit Index=.958; and 3) Root Mean Square Residual=.056. The glucose testing Pros factor consisted of items that loaded from .68 to .87, and its internal consistency rating (coefficient alpha) was .91. The Glucose testing Cons factor consisted of items that loaded from .52 to .80, and it had a coefficient alpha of .81. The correlation of the Pros and Cons of glucose testing was -0.128, see Tables 8 and 9, and Figure 1.

Comparison models. In order to test one's choice of a model, one should test several plausible alternative models, this way, either a better fitting model will be found or the model of interest will be confirmed. Two of the alternative models chosen are used as baselines. These are the null model and the random two factor correlated model. The null model forces each item to act as a factor, none of which are allowed to be related to any others. The random two factor correlated model forces random items to be assigned to each of two factors that are allowed to correlate. The other two alternative models were plausible models. One was a one factor model, which asserts that all items are part of one construct. Some items may be on one end of the construct and other items may be on the other end, but they are all part of one construct. The other model was a two factor uncorrelated model, which asserts that the items represent two unrelated constructs. The results of the alternative models are also presented in Tables 8 and 9.

First, was the null model. Its fit indices were: 1) $\chi^2_{(66)}$=2998.30, p <.001; 2) Goodness of Fit Index=.435; and 3) Root Mean Square Residual=.316; but, by definition, the factor loadings and coefficient alphas cannot be computed. Second, was the two factor random model. It did not converge, hence, there are no fit indices, factor loadings, or

coefficient alphas to report. Third, was the one factor model. Its fit indices were: 1) $\chi^2_{(54)}$=1067.24, p <.001; 2) Goodness of Fit Index=.683; and 3) Root Mean Square Residual=.183. The single factor consisted of items that loaded from -.20 to .88; its coefficient alpha was .76. Last, was the two factor *un*correlated model. Its fit indices were: 1) $\chi^2_{(54)}$=164.71, p <.001; 2) Goodness of Fit Index=.956; and 3) Root Mean Square Residual=.065. The glucose testing Pros factor consisted of items that loaded from .68 to .87, and the glucose testing Cons factor consisted of items that loaded from .52 to .80. The coefficient alphas for the Pros and Cons of glucose testing in *this* model are, by definition, the same as for the two factor correlated model (Pros alpha=.91, Cons alpha=.81).

Chi-square difference tests were performed in order to test whether or not significant differences existed between the proposed theoretical model and each of the alternative models. These results are presented in Table 10. The proposed model (the two factor correlated model) explained significantly more than even the next best alternative model (the two factor uncorrelated model).

Since both the null model and the one factor model, as evidenced by their fit indices, were such poor models, they were both enormously different from the two factor correlated model. The random model was so poor that it could not even be compared (because it did not converge). The differences between the two factor uncorrelated model and the two factor correlated model are minimal, however, the correlated model does fit better (has a lower χ^2 and RMSR, and has a higher GFI). Therefore, while the differences between the fit indices of the two best models were slight, the two factor correlated model does explain the data best (fits the data significantly better than the uncorrelated model).

Cross validation. Using the confirmatory subsample (n=607), the two factor correlated model still fared quite well. Its fit indices were: 1) $\chi^2_{(54)}$=227.73, p <.001; 2) Goodness of Fit Index=.941; and 3) Root Mean Square Residual=.057. The glucose testing Pros factor consisted of items that loaded from .71 to .83, and its coefficient alpha was .89. The glucose testing Cons factor consisted of items that loaded from .53 to .77, and its coefficient alpha was .81 (see Tables 8 and 9). The correlation of the Pros and the Cons of glucose testing was -0.092 (see Figure 2).

Applicability of final model to sub-populations. In order to determine the applicability of this new measure to different subsamples of people with diabetes, the whole data set was broken down into three subsamples: 1) people with type I diabetes (n=202), 2) people with type II diabetes who are on insulin (n=723), and 3) people with type II diabetes who are not on insulin (n=189). Next, these subgroups were combined into: all insulin users (n=925), and all participants with Type II diabetes (n=912). Finally, the model was tested on the entire sample (n=1186).

For participants with Type I diabetes, the fit indices were: 1) $\chi^2_{(53)}$=131.90, p<.001; 2) Goodness of Fit Index=.904; and 3) Root Mean Square Residual=.078. The glucose testing Pros factor consisted of items that loaded from .68 to .86, and its coefficient alpha was .91. The glucose testing Cons factor consisted of items that loaded from .51 to .84, and its coefficient alpha was .81. For the Type II subsample using insulin, the fit indices were: 1) $\chi^2_{(53)}$=224.91, p<.001; 2) Goodness of Fit Index=.950; and 3) Root Mean Square Residual=.057. The glucose testing Pros factor consisted of items that loaded from .69 to .87, and its coefficient alpha was .90. The glucose testing Cons factor consisted of items that loaded from .55 to .74, and its coefficient alpha was .81. For the

Type II subsample not using insulin, the fit indices were: 1) $\chi^2_{(53)}$=142.27, p<.001; 2) Goodness of Fit Index=.893; and 3) Root Mean Square Residual=.075. The glucose testing Pros factor consisted of items that loaded from .68 to .84, and its coefficient alpha was .89. The glucose testing Cons factor consisted of items that loaded from .31 to .90, and its coefficient alpha was .73.

For the subsample of insulin users, the fit indices were: 1) $\chi^2_{(53)}$=271.81, p<.001; 2) Goodness of Fit Index=.953; and 3) Root Mean Square Residual=.056. The glucose testing Pros factor consisted of items that loaded from .69 to .85, and its coefficient alpha was .90. The glucose testing Cons factor consisted of items that loaded from .55 to .77, and its coefficient alpha was .81. For the subsample of all Type II participants, the fit indices were: 1) $\chi^2_{(53)}$=291.52, p<.001; 2) Goodness of Fit Index=.949; and 3) Root Mean Square Residual=.055. The glucose testing Pros factor consisted of items that loaded from .70 to .87, and its coefficient alpha was .90. The glucose testing Cons factor consisted of items that loaded from .52 to .76, and its coefficient alpha was .80. For the whole sample, the fit indices were: 1) $\chi^2_{(53)}$=340.89, p<.001; 2) Goodness of Fit Index=.954; and 3) Root Mean Square Residual=.054. The glucose testing Pros factor consisted of items that loaded from .69 to .86, and its coefficient alpha was .90. The glucose testing Cons factor consisted of items that loaded from .53 to .79, and its coefficient alpha was .81. These results are presented in Tables 11 and 12.

Staging Algorithms

Given the high proportion of participants in the Action and Maintenance stages (already presented in Table 3), an attempt was made to validate this by using other behavioral indicators. Consequently, some participants were removed from the Action

and Maintenance stages based on their reported and recomended testing frequencies. If participants were testing as often as they were told by their physicians to test, they were kept in Action and Maintenance; if they were testing less often, they were put in the "Don't Know Standard" (or DK) group (see Table 13).

Using this new staging method, a crosstab of the single- and four-item staging algorithms for glucose testing adherence was performed. The two overlapped (indicated the same stage) for 89.4% of the participants. Allowing a one-stage margin-of-error in each direction, the two algorithms were off for 4.8% of the participants. Furthermore, when looking at the crosstabs for each staging algorithm by number of times in the past year participants have skipped testing their glucose levels, the anticipated pattern emerged--as people progressed through the stages, they skipped their glucose testing less. This pattern was true for both the single-item and the four-item staging algorithms, and the two were almost exactly the same. Since the two algorithms are so similar, and since more data is lost as the number of items increases, logic would suggest using the most parsimonious algorithm--the one-item algorithm.

Predicting Stage from Decisional Balance: Discriminant Function Analysis (DFA)

A Discriminant Function Analyses (DFA) was performed to predict in what stage the DK group would best belong in a five stage model. The DFA used the two decisional balance variables (the Pros and Cons of glucose testing) as predictors of membership in one categorical dependent variable (the five stages of change for glucose testing). Of the original 1573 participants with decisional balance or staging for glucose testing, 1250 had both, and were testing their blood (those testing only their urine were excluded). The DFA left the DK stage as "ungrouped" cases and only the "grouped" cases (the first five

stages) are used for the actual analysis; those results, were used to classify the "ungrouped" cases into one of the five stages. Therefore, while the analyses predicted group membership for the 220 participants in the DK group, the analysis was based on only the 1030 participants who are in PC, C, P, A, or M.

Two discriminant functions were derived, both functions were significant predictors of stage. Function one had a Wilks' $\lambda = .622$, $p<.001$, and accounted for 35.32% of the total variance, function two had a Wilks' $\lambda = .962$, $p<.001$, and accounted for 3.82% of the total variance. The first function separates all five of the stages, then the second function separates the "stable" stages (PC and M) from the "unstable" stages (C, P, and A). Classifying the DK group, 9.5% were placed in PC, 12.7% were placed in C, 18.6% were placed in P, 21.4% were placed in A, and 37.7% were placed in M (see Table 14).

Stage Differences on Decisional Balance: Multivariate Analysis of Variance (MANOVA)

Decisional balance by stage and gender. In order to determine whether or not men and women differed across the stages of change on decisional balance, a 5x2 between-subjects MANOVA was performed. The two independent variables were glucose testing stage (PC, C, P, A, and M) and gender (male and female). The dependent variables (DVs) were the Pros and Cons of glucose testing and they were entered at the same time. Those in the DK group and those who tested their glucose only by urine were excluded. There were 1028 participants included in the analysis.

Using the Wilks' criterion, the combined DVs were not significantly affected by the interaction of stage and gender, $F_{(8, 2034)}=1.422$, $p>.05$, but were significantly affected independently by both stage, $F_{(8, 2034)}=66.393$, $p<.001$ and gender, $F_{(2, 1017)}=6.089$, $p<.01$.

The effect of stage was very strong (η^2=.207), however, the effect of gender was very weak (η^2=.011).

Since the interaction of stage and gender in the MANOVA was not significant, no two-way follow-up ANOVAs were done, however, each of the significant one-way MANOVAs (stage and gender) were followed up with one-way ANOVAs.

Looking at stage of change for glucose testing, the ANOVA for the Pros of glucose testing was significant, $F_{(4, 1018)}$=88.792, p<.001, as was the ANOVA for the Cons of glucose testing, $F_{(4, 1018)}$=47.241, p<.001. The effect size of the Pros was very strong (η^2=.259) and the effect size of the Cons was moderate (η^2=.157). See Table 15 for means and standard deviations of the glucose testing Pros and Cons by stage of change for glucose testing. See Figure 3 for the pattern of glucose testing Pros and Cons across the Stages of Change for glucose testing.

Following the ANOVAs, Tukey Pairwise-Comparisons were used to determine which stages were significantly different from one another. Regarding the Pros of glucose testing, those in Precontemplation were different from everyone; Contemplation and Preparation did not differ from each other, but both of them differed from Action and Maintenance. As for the later stages, those in Action and Maintenance differed from those in the early stages (PC, C, and P), and those in Action were different from those in Maintenance (see Table 15).

Regarding the Cons of glucose testing, those in Precontemplation, Contemplation, and Preparation did not differ from one another, but all of them differed from those in Maintenance; Contemplation and Preparation also differed from those in Action. As for

the later stages, those in Action differed from those in Maintenance; and those in Maintenance differed from everyone (see Table 15).

Looking at gender, the ANOVA for the Pros of glucose testing was significant, $F_{(1, 1018)}=8.642$, $p<.01$, as was the ANOVA for the Cons of glucose testing, $F_{(1, 1018)}=4.453$, $p<.05$. The effect sizes of both the Pros and the Cons were small (Pros: $\eta^2=.008$, Cons: $\eta^2=.004$). See Table 15 for means and standard deviations of the glucose testing Pros and Cons by gender. See Figure 4 for the pattern of glucose testing Pros and Cons across gender. No Tukey tests were needed for the Cons of glucose testing by gender, because there were only two groups (male and female).

Decisional balance by stage and type of diabetes. Because there were very few Type I people in the Action stage of glucose testing, the two stages of Action and Maintenance were collapsed. Therefore, a 4x3 between-subjects MANOVA was performed on two dependent variables, which were the Pros and Cons of glucose testing. The two independent variables were glucose testing stage (PC, C, P, and A/M) and type of diabetes (type I, type II using insulin, and type II not using insulin).

Using the Wilks' criterion, the combined DVs were not significantly affected by the interaction of stage and type, $F_{(12, 1904)}=1.688$, $p>.05$, but were significantly affected independently both by stage, $F_{(6, 1904)}=63.138$, $p<.001$, and by type, $F_{(4, 1904)}=3.057$, $p<.05$. The effect size of stage on the DVs was strong ($\eta^2=.166$), but the effect size of type on the DVs was very weak ($\eta^2=.006$). For a summary of all the MANOVAs (see Table 15).

Since the interaction of stage of change and type of diabetes in the MANOVA was not significant, no two-way ANOVAs were done. The significant one-way MANOVAs were followed up with one-way ANOVAs. The ANOVAs on stage will not be reported

again for either the Pros or the Cons of glucose testing, since they were already reported above. Looking at type of diabetes, the ANOVA on the Pros of glucose testing was not significant, $F_{(2, 953)}=0.021$, $p>.05$. The ANOVA on the Cons of glucose testing was significant, $F_{(2, 953)}=6.115$, $p<.01$, but with a small effect size ($\eta^2=.013$). See Table 15 for means and standard deviations of the glucose testing Pros and Cons by type of diabetes. See Figure 5 for the pattern of glucose testing Pros and Cons across type of diabetes.

The follow-up Tukey Pairwise-Comparison test showed that on the Cons of glucose testing, the participants with type I diabetes were significantly different from type II participants who were on insulin, but not from type II particiapants who were not on insulin. The two categories of type II participants, however, were not different from one another.

Medication

The sample of 1573 subjects with complete medication decisional balance data was randomly split into exploratory and confirmatory subsamples of n=784 and n=789, respectively.

Medication Decisional Balance Measure Development

Principal Components Analysis (PCA). Using the exploratory subsample (n=784), a PCA was conducted on the 18x18 matrix of interitem correlations. MAP suggested a two component solution with all items loading on their theoretically appropriate constructs (.468-.782 and .588 to .732), accounting for 46.2% of the variance. .Using an oblique rotation, the two factors had a correlation of .070. PA suggested a four component solution (accounting for 59.5% of the variance). The third component, suggested by PA, was composed of four con items that were mostly related to taking medication. One of

these items was complex, and loaded poorly on the two constructs on which it did load. The fourth component, suggested by PA, was composed of three pro items and one con item most of which were related to satisfaction. Two of these items were complex and both of them loaded poorly on the constructs on which they did load. Hence, the third and fourth factors were fairly weak.

Confirmatory Factor Analysis (CFA): Two Factor Correlated Model. Given that the requested two-factor PCA solution resulted in all of the items loading on their theoretically appropriate constructs, an attempt was made to *impose* the theoretical, two-factor correlated structure using the exploratory sample. After several iterations of models, deleting items at each step that loaded less than .50 on their appropriate factor, items that loaded .30 or higher on both factors, and items that had extremely high modification indices, the final measure consisted of six Pros of medication and six Cons of medication. The fit indices for this model were: 1) $\chi^2_{(53)}=202.51$, $p<.001$; 2) Goodness of Fit Index=.959; and 3) Root Mean Square Residual=.040. The Pros factor consisted of items that loaded from .67 to .81, and its internal consistency rating (coefficient alpha) was .86. The Cons factor consisted of items that loaded from .51 to .78, and it had a coefficient alpha of .81. The correlation of the Pros of medication adherence and the Cons of medication adherence was -0.089 (see Tables 16 and 17 and Figure 6).

Comparison models. As was previously stated, in order to test one's choice of a model, one should test several plausible alternative models. The same set of alternative models were tested with the medication decisional balance, because the same theory was being tested. The results to the alternative models are presented in Tables 16 and 17.

First, was the null model. Its fit indices were: 1) $\chi^2_{(66)}$=3340.34, p<.001; 2) Goodness of Fit Index=.472; and 3) Root Mean Square Residual=.294; but, by definition, the factor loadings and coefficient alphas cannot be computed. Second, was the two factor random model. Its fit indices were: 1) $\chi^2_{(53)}$=1490.30, p<.001; 2) Goodness of Fit Index=.677; and 3) Root Mean Square Residual=.186. The first factor consisted of items that loaded from -0.13 to .82, and its coefficient alpha was .55. The second factor consisted of items that loaded from -0.10 to .74, and its coefficient alpha was also .55. Third, was the one factor model. Its fit indices were: 1) $\chi^2_{(54)}$=1499.48, p<.001; 2) Goodness of Fit Index=.676; and 3) Root Mean Square Residual=.186. The single factor consisted of items that loaded from -.132 to .81; its coefficient alpha was .74. Finally, was the two factor uncorrelated model. Its fit indices were: 1) $\chi^2_{(54)}$=206.99, p<.001; 2) Goodness of Fit Index=.958; and 3) Root Mean Square Residual=.048. The Pros factor consisted of items that loaded from .67 to .82, and its coefficient alpha, by definition, was the same as for the two factor correlated model (.86). The Cons factor consisted of items that loaded from .51 to .78, and its coefficient alpha was also the same as for the two factor correlated model (.81).

Chi-square difference tests were performed in order to test whether or not significant differences existed between the proposed theoretical model and each of the alternative models. These results are presented in Table 18. The theoretical model (the two factor correlated model) explained significantly more than even the next best alternative model (the two factor uncorrelated model).

As can be seen, the differences between the null model, the one factor model, and the random model each compared to the two factor correlated model were all enormous.

These three comparison models, as expected and as evidenced by their fit indices, were all poor models. However, the differences between the two factor uncorrelated model and the two factor correlated model are minimal. The correlated model does do better (has a lower χ^2 and RMSR and a higher CFI). Therefore, as with the glucose testing decisional balance, while the differences between the fit indices of the two best models were slight, the two factor correlated model seems to explain the data best.

Cross validation. Using the confirmatory subsample (n=789), the two factor correlated model still fared quite well. The fit indices were: 1) $\chi^2_{(53)}$=201.24, p<.001; 2) Goodness of Fit Index=.957; and 3) Root Mean Square Residual=.046. The Pros factor consisted of items that loaded from .64 to .81, and its coefficient alpha was .83. The Cons factor consisted of items that loaded from .52 to .77, and its coefficient alpha was .82. The correlation of the Pros and the Cons of medication adherence was -0.003 (see Figure 7).

Applicability of final model to sub-populations. In order to determine the applicability of this new measure to different subsamples of people with diabetes, the data was broken down into three subsamples: 1) people with type I diabetes (n=234); 2) people with type II diabetes who are on insulin (n=855); and 3) people with type II diabetes who are not on insulin (n=388). Finally, the model was tested on the entire sample (n=1573).

For the Type I subsample, the fit indices were: 1) $\chi^2_{(53)}$=118.87, p<.001; 2) Goodness of Fit Index=.920; and 3) Root Mean Square Residual=.052. The Pros factor consisted of items that loaded from .63 to .86, and its coefficient alpha was .88. The Cons factor consisted of items that loaded from .52 to .72, and its coefficient alpha was .79. For the Type II subsample using insulin, the fit indices were: 1) $\chi^2_{(53)}$=196.30, p<.001; 2)

Goodness of Fit Index=.962; and 3) Root Mean Square Residual=.046. The Pros factor consisted of items that loaded from .61 to .81, and its coefficient alpha was .84. The Cons factor consisted of items that loaded from .52 to .74, and its coefficient alpha was .82. For the Type II subsample not using insulin, the fit indices were: 1) $\chi^2_{(53)}$=123.10, p<.001; 2) Goodness of Fit Index=.948; and 3) Root Mean Square Residual=.050. The Pros factor consisted of items that loaded from .64 to .79, and its coefficient alpha was .84. The Cons factor consisted of items that loaded from .50 to .72, and its coefficient alpha was .80. For the whole sample, the fit indices were: 1) $\chi^2_{(53)}$=309.15, p<.001; 2) Goodness of Fit Index=.967; and 3) Root Mean Square Residual=.040. The Pros factor consisted of items that loaded from .64 to .81, and its coefficient alpha was .85. The Cons factor consisted of items that loaded from .52 to .77, and its coefficient alpha was .81. These results are presented in Tables 19 and 20.

Staging Algorithms

Insulin adherence. Given that the vast majority of subjects were in Maintenance, a cross-check was done to validate this. If subjects were taking at least as much insulin as they were supposed to be taking, they stayed in Maintenance, otherwise, they were put into a DK group. There were no subjects in Contemplation. Doing a crosstab of the single-item and four-item staging algorithms for insulin adherence, the two new algorithms overlapped for 98.3% of the subjects. Allowing a one-stage margin-of-error in each direction, the two algorithms were off for only 0.5% of the subjects. Furthermore, when looking at the crosstab of stage by number of times in the past year subjects have skipped their insulin, the anticipated pattern emerged--as people progressed through the stages, they skipped their insulin shots less. This pattern was true for both the single-item and the

four-item staging algorithms, and the two were very similar. Since the two algorithms are so similar, and since more data is lost as the number of items increases, logic would suggest using the most parsimonious algorithm--the one-item algorithm.

Pill adherence. As with insulin, the vast majority of subjects were in Maintenance. So, again, a cross-check was done to validate this. If subjects were taking at least as much medication as they were supposed to be taking, they stayed in Maintenance, otherwise, they were put into a DK group. Again, there were no subjects in Contemplation. Doing a crosstab of the single-item and four-item staging algorithms for pill adherence, the two overlapped for 95.2% of the subjects. Allowing a one-stage margin-of-error in each direction, the two algorithms were off for only 2.5% of the subjects. As with insulin, when looking at the crosstab of stage by number of times in the past year subjects have skipped their pills, the anticipated pattern emerged--overall, as people progressed through the stages, they skipped their pills less. This pattern was true for both the single-item and the four-item staging algorithms. Since the two algorithms are so similar, and since more data is lost as the number of items increases, logic would suggest using the most parsimonious algorithm--the one-item algorithm.

Stage Differences on Decisional Balance: Multivariate Analysis of Variance (MANOVA)

Decisional balance by stage and gender. To determine whether or not males and females differed across the stages of change on decisional balance, a 4x2 between-subjects MANOVA was performed. The two independent variables were medication stage (PC, C/P, A, and M) and gender (male and female). The dependent variables were the Pros and Cons of medication adherence and they were entered at the same time. There were 1048 subjects included in the analysis.

Using the Wilks' criterion, neither the interaction of stage and gender, $F_{(6, 2078)}=0.764$, $p>.05$, nor the main effect of gender, $F_{(2, 1039)}=0.907$, $p>.05$, were significant. The main effect for stage, $F_{(6, 2078)}=13.806$, $p<.001$, was significant, however, its effect size was weak ($\eta^2=.038$).

Since neither the interaction of stage and gender nor the main effect for gender were significant in the MANOVA, the two-way follow-up ANOVAs and the one-way follow-up ANOVAs for gender were not done on the Pros or the Cons of medication adherence. Only the significant one-way MANOVA on decisional balance by stage of change was followed-up by one-way ANOVAs and Tukey tests on each dependent variable.

The ANOVA for the medication Pros was significant, $F_{(3, 1040)}=18.371$, $p<.001$, as was the ANOVA for medication Cons, $F_{(3, 1040)}=9.403$, $p<.001$. The effect sizes, however, were both weak (Pros: $\eta^2=.050$; Cons: $\eta^2=.026$). See Table 21 for means and standard deviations of the medication Pros and Cons by stage of change for medication. See Figure 8 for the pattern of the medication Pros and Cons across the stages of change for medication.

Tukey Pairwise-Comparisons were used to determine which stages were significantly different from one another. Regarding the Pros of medication adherence, those in Precontemplation and the Contemplation/Preparation group were different from those in Action and Maintenance. Similarly, regarding the Cons of medication adherence, those in Precontemplation and the Contemplation/Preparation group were different from those in Maintenance.

Decisional balance by stage and type of diabetes. To determine whether or not people with different types of diabetes differed across the stages of change on decisional balance, a 4x3 between-subjects MANOVA was performed. The two independent variables were medication stage (PC, C/P, A, and M) and type of diabetes (type I, type II using insulin, and type II not using insulin). The dependent variables were the Pros and Cons of medication adherence and they were entered at the same time. There were 985 subjects included in the analysis.

Using the Wilks' criterion, the interaction of stage and type was significant, $F_{(12, 1944)}=3.883$, $p<.001$, hence, the main effects of type and stage were not investigated. The effect size, however, was weak ($\eta^2=.023$).

Since the interaction of stage and type in the MANOVA was significant, two-way follow-up ANOVAs were done on each the Pros and the Cons of medication adherence. The interaction of stage and type on the ANOVA for the medication Pros was significant, $F_{(6, 973)}=6.626$, $p<.001$, however, its effect size was small ($\eta^2=.039$). The interaction of stage and type on the ANOVA for the medication Cons was not significant, $F_{(6, 973)}=1.135$, $p>.05$. The significant main effect for stage was already presented above (see Table 21 and Figure 9). Tukey Pairwise-Comparisons cannot be computed for two-way interactions.

Discussion

The first objective for each of the two behaviors was to develop decisional balance measures. This was accomplished by using a series of exploratory and confirmatory procedures to determine and verify the structure of each measure. Exploratory procedures included a PCA, a series of measurement models (used to determine poor items that

should be deleted), and several alternative measurement models (serving as comparisons). Confirmatory procedures included verifying the selected model on the second half of the data, as well as applying this model to several different subsamples. Overall, it was found that the typical, expected two factor correlated decisional balance model fit both the glucose testing and the medication adherence behaviors. In addition to fitting the second half of the data, final model did respectably well on all the subsamples of different types of diabetes, and quite well on the entire sample. Once again, the decisional balance model of the TTM held up.

The second objective for each of the two behaviors was to develop staging measures. This was accomplished by a series of crosstabs to determine the differences between the two staging algorithms for each behavior and also the validity of each staging algorithm as reflected by several related behavioral variables. The results showed remarkable similarity of the single- and four-item algorithms not only when compared to one another, but also when each was compared to related behavioral variables. Moreover, the similar results of the cross validations done between each of the algorithms and across other related behavioral variables indicates that the algorithm does seem to be measuring the construct of stage, and people are consistent in their answers. Additionally, it is noteworthy that the percentages of people in the Action and Maintenance stages are consistent with adherence rates in previous diabetes self-management literature.

Finally, group differences on decisional balance were found using MANOVAs, looking at stage of change, gender, and type of diabetes. Regarding main effects, there were significant differences on decisional balance by stage of change for both of the investigated behaviors, all in the expected directions. These differences indicate the

amount of change needed to progress through the stages of change. There ware also significant differences on decisional balance by gender, but only on glucose testing, not on medication. So, men and women judge the advantages and disadvantages of glucose testing differently, but judge the advantages and disadvantages of medication similarly. Regarding type of diabetes, there was a main effect for glucose testing, but type of diabetes interacted with stage of change for medication (discussed below; this was the only significant interaction). This means that people with different types of diabetes judge the advantages and disadvantages of glucose testing differently.

The lack of interactions between stage and gender for both behaviors, shows that even though men and women weight the advantages and disadvantages of glucose testing differently, they change the same way across the stages of change. Similarly, the lack of interaction between stage and type for glucose testing, shows that people with different types of diabetes change the same way across the stages of change. This lack of interactions is a powerful statement in support of the TTM.

On a theoretical level, the interaction between stage and type of diabetes for medication adherence is understandable, given that the medication regimens are so very different for the different types of diabetes. This interaction, however, may actually just be a product of the staging distribution rather than a meaningful difference between the groups. While the distribution of stage was skewed for both behaviors, it was tremendously skewed for medication adherence. This tremendous skewness produces unreliability in the data and it could be argued that stage of change for medication was so skewed that it was no longer meaningful and its results were not interpretable. Decisional balance scores are standardized, which is most useful among evenly distributed categorical

variables. Tremendous skewness leads to very heavy weighting at one end of the distribution, and very little weighting at the other therefore, the scores at one end of the distribution will be very close to the mean, and those at the other end will be very extreme. This skewness, however, is not likely to be due to the sampling procedures given that the sample was proactively recruited from a representative sample of people with diabetes and the response rate was so high. Since sampling does not seem to be an issue, then more work may need to be done to better understand the Stages of Change in the medication area.

As was previously shown, diabetes has a tremendous impact, not only on patients, but also on the health care system and society. If the development and successful application of a stage-based behavior change program for the self-management of diabetes were to help prevent the development, slow the progression, and alleviate the symptoms of the many complications of diabetes, it could then in turn have a tremendous impact on patients, the health care system, and society. The development of these measures is one step in the direction of developing interventions. In order to develop interventions, however, measures need to be developed for the other constructs of the TTM. As evidenced by all of these findings, the staging and decisional balance constructs of the TTM can now be said to hold up outside the cancer prevention field. There is now promise for the application of the TTM in at least one area of chronic disease.

Table 1 ***Frequencies for the Representative and Augmented Samples Across the Whole Sample and by Type of Diabetes***

		Type of Diabetes					
	Total Sample	Type I		Type II, Insulin		Type II, No Insulin	
Sample	N	N	(%)	N	(%)	N	(%)
Representative	988	72	(8.1)	289	(32.7)	524	(59.2)
Augmented	1068	186	(18.8)	760	(76.8)	44	(4.3)
Total	2056	258	(12.5)	1049	(51.0)	568	(27.6)

Table 2 ***Demographics and Key Variables for the Whole Sample and by Type of Diabetes***

DEMOGRAPHICS	Total		Type I		Type II, Insulin		Type II, No Insulin	
	N	(%)	N	(%)	N	(%)	N	(%)
Gender								
Male	784	(38.2)	107	(41.5)	392	(37.5)	230	(40.5)
Female	1267	(61.8)	151	(58.5)	654	(62.5)	338	(59.5)
Race								
Hispanic	25	(1.2)	4	(1.6)	12	(1.2)	7	(1.2)
African American	107	(5.3)	7	(2.8)	59	(5.7)	27	(4.8)
Asian	12	(0.6)	-----	-----	5	(0.5)	4	(0.7)
Native American	466	(23.0)	25	(9.8)	241	(23.3)	154	(27.5)
Caucasian	1414	(69.9)	218	(85.8)	716	(69.3)	369	(65.8)
Marital Status								
Married	1272	(62.0)	166	(64.3)	643	(61.5)	348	(61.4)
Sep/Div/Wid	560	(27.3)	28	(10.9)	320	(30.6)	171	(30.2)
Single	176	(8.6)	43	(16.7)	74	(7.1)	38	(6.7)
Single, with Sig. Other	42	(2.0)	21	(8.1)	9	(0.9)	10	(1.8)
Living Arrangement								
With Partner	1289	(62.8)	174	(67.7)	639	(61.0)	359	(63.3)
With Others	291	(14.2)	44	(17.1)	156	(14.9)	69	(12.2)
Alone	464	(22.6)	39	(15.2)	245	(23.4)	138	(24.3)
In a Care Facility	9	(0.4)	-----	-----	8	(0.8)	1	(0.2)
Working Status								
Full Time	466	(23.3)	122	(48.0)	173	(17.0)	132	(23.8)
Part Time	151	(7.6)	25	(9.8)	69	(6.8)	41	(7.4)
Unemployed	72	(3.6)	21	(8.3)	34	(3.3)	9	(1.6)
Retired	877	(43.9)	17	(6.7)	525	(51.5)	272	(49.1)
Homemaker	307	(15.4)	46	(18.1)	146	(14.3)	81	(14.6)
Other	124	(6.2)	23	(9.1)	72	(7.1)	19	(3.4)
Education								
Some High School	325	(16.2)	21	(8.3)	177	(17.2)	92	(16.7)
High School	742	(37.0)	78	(30.8)	400	(38.8)	207	(37.6)
Some College	538	(26.8)	74	(29.2)	278	(27.0)	144	(26.1)
College	206	(10.3)	45	(17.8)	89	(8.6)	51	(9.3)
Post-Graduate	194	(9.7)	35	(13.8)	86	(8.3)	57	(10.3)
DCCT								
Heard of and Aware	387	(19.3)	91	(35.7)	206	(19.9)	59	(10.6)
Heard of and Not Aware	245	(12.2)	33	(12.9)	136	(13.2)	61	(10.9)
Not Heard of and Not Aware	1377	(68.5)	131	(51.4)	692	(66.9)	439	(78.5)
Type								
Type I	258	(13.8)	258	(100.0)	-----	---	-----	---
Type II, on insulin	1049	(55.9)	-----	---	1049	(100.0)	-----	---
Type II, not on insulin	568	(30.2)	-----	---	-----	---	568	(100.0)

	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Age	59.1	(14.1)	39.7	(11.1)	62.8	(10.8)	62.3	(12.2)
Age at Diagnosis	45.8	(17.2)	15.8	(7.6)	49.9	(11.4)	54.5	(11.5)
BMI	30.1	(8.1)	25.9	(6.1)	30.9	(8.1)	30.8	(8.3)

Table 3 ***Stage Distributions Using the One-Item Algorithm for All Three Behaviors Prior to Re-Staging Across the Whole Sample and by Type of Diabetes***

STAGES OF CHANGE	Total		Type I		Type II, Insulin		Type II, No Insulin	
	N	%	N	%	N	%	N	%
Glucose Testing Stage								
Precontemplation	73	(4.6)	19	(8.0)	33	(3.6)	16	(5.1)
Contemplation	69	(4.4)	11	(4.6)	38	(4.2)	12	(3.8)
Preparation	130	(8.3)	20	(8.4)	59	(6.5)	37	(11.8)
Action	146	(9.3)	15	(6.3)	69	(7.6)	51	(16.3)
Maintenance	1156	(73.4)	172	(72.6)	710	(78.1)	197	(62.9)
Total	1574		258		909		313	
Medication Stage-- Overall								
Precontemplation	24	(1.3)	3	(1.2)	9	(0.9)	7	(1.5)
Contemplation	4	(0.2)	2	(0.8)	1	(0.1)	1	(0.2)
Preparation	17	(0.9)	1	(0.4)	5	(0.5)	10	(2.1)
Action	77	(4.1)	3	(1.2)	45	(4.3)	22	(4.7)
Maintenance	1755	(93.5)	247	(96.5)	976	(94.2)	427	(91.4)
Total	1877		256		1036		467	
Medication Stage-- Insulin								
Precontemplation	14	(1.0)	3	(1.2)	9	(0.9)	-----	-----
Contemplation	3	(0.2)	2	(0.8)	1	(0.1)	-----	-----
Preparation	6	(0.4)	1	(0.4)	5	(0.5)	-----	-----
Action	50	(3.7)	3	(1.2)	45	(4.4)	-----	-----
Maintenance	1296	(94.7)	247	(96.5)	973	(94.2)	-----	-----
Total	1369		256		1033		-----	
Medication Stage-- Pills								
Precontemplation	29	(4.0)	-----	-----	18	(9.4)	7	(1.5)
Contemplation	2	(0.3)	-----	-----	1	(0.5)	1	(0.2)
Preparation	12	(1.7)	-----	-----	1	(0.5)	10	(2.1)
Action	44	(6.1)	-----	-----	15	(7.9)	22	(4.7)
Maintenance	631	(87.9)	-----	-----	156	(81.7)	427	(91.4)
Total	718		-----		191		467	

Table 4 *General Health Status Variables Across the Whole Sample and by Type of Diabetes*

HEALTH STATUS: General	Total		Type I		Type II, Insulin		Type II, No Insulin	
	N	(%)	N	(%)	N	(%)	N	(%)
Eye problems (retinopathy)								
Yes	618	(30.1)	122	(47.3)	350	(33.4)	99	(17.4)
No	1438	(69.9)	136	(52.7)	699	(66.6)	469	(82.6)
Kidney problems (nephropathy)								
Yes	240	(11.7)	48	(18.6)	139	(13.3)	35	(6.2)
No	1816	(88.3)	210	(81.4)	910	(86.7)	533	(93.8)
Decrease or loss of feeling in legs or feet (neuropathy)								
Yes	736	(35.8)	95	(36.8)	460	(43.9)	125	(22.0)
No	1320	(64.2)	163	(63.2)	589	(56.1)	443	(78.0)
Foot problems (ulcers, infections, sores)								
Yes	339	(16.5)	45	(17.4)	200	(19.1)	65	(11.4)
No	1717	(83.5)	213	(82.6)	849	(80.9)	503	(88.6)
Sexual problems								
Yes	451	(21.9)	49	(19.0)	268	(25.5)	107	(18.8)
No	1605	(78.1)	209	(81.0)	781	(74.5)	461	(81.2)
High Blood Pressure (hypertension)								
Yes	991	(48.2)	70	(29.1)	553	(52.7)	301	(53.0)
No	1065	(51.8)	188	(72.9)	496	(47.3)	267	(47.0)
Angina								
Yes	341	(16.6)	28	(10.9)	229	(21.8)	59	(10.4)
No	1715	(83.4)	230	(89.1)	820	(78.2)	509	(89.6)
Congestive Heart Disease								
Yes	278	(13.5)	14	(5.4)	197	(18.8)	47	(8.3)
No	1778	(86.5)	244	(94.6)	852	(81.2)	521	(91.7)
Heart Attack								
Yes	266	(12.9)	17	(6.6)	179	(17.1)	52	(9.2)
No	1790	(87.1)	241	(93.4)	870	(82.9)	516	(90.8)
Stroke								
Yes	150	(7.3)	14	(5.4)	96	(9.2)	30	(5.3)
No	1906	(92.7)	244	(94.6)	953	(90.8)	538	(94.7)

	M	(SD)	M	(SD)	M	(SD)	M	(SD)
# Complications	3.8	(2.7)	3.4	(2.8)	4.4	(2.7)	3.3	(2.2)
# Hospital admissions (year)	0.2	(2.0)	0.3	(0.9)	0.3	(2.7)	0.0	(0.3)
# Days in the hosp. (all adms)	10.4	(13.2)	12.2	(18.4)	9.9	(11.8)	12.7	(13.5)
# ER admissions (year)	0.9	(14.5)	2.6	(31.3)	0.4	(1.6)	0.1	(0.7)
# Routine doctor's visits (year)	5.3	(6.9)	5.4	(7.8)	5.9	(7.3)	4.3	(5.3)
# Days of work missed (year)	1.5	(8.9)	2.0	(9.3)	2.3	(12.2)	0.4	(1.9)

Table 5 ***Health Status Variables Specific to Glucose Testing Across the Whole Sample and by Type of Diabetes***

HEALTH STATUS: Glucose Testing	Total		Type I		Type II, Insulin		Type II, No Insulin	
	N	(%)	N	(%)	N	(%)	N	(%)
Told to test glucose								
Yes	1647	(81.0)	245	(95.3)	966	(92.4)	313	(55.6)
No	386	(19.0)	12	(4.7)	80	(7.6)	250	(44.4)
How do you test your glucose?								
Urine	49	(3.2)	3	(1.3)	17	(1.9)	24	(7.9)
Strips	96	(6.2)	17	(7.5)	49	(5.4)	22	(7.3)
Meter	1400	(90.6)	207	(91.2)	834	(92.7)	256	(84.8)
# Times skipped for 1 day or more in the last year								
Never	541	(34.8)	82	(35.0)	347	(38.6)	76	(24.6)
1-5 times	364	(23.4)	47	(20.1)	219	(24.3)	74	(23.9)
6-10 times	166	(10.7)	24	(10.3)	79	(8.8)	50	(16.2)
11-20 times	143	(9.2)	17	(7.3)	80	(8.9)	35	(11.3)
21 or more times	342	(22.0)	64	(27.4)	175	(19.4)	74	(23.9)

	M	(SD)	M	(SD)	M	(SD)	M	(SD)
# Times told to test glucose per week	10.3	(8.4)	16.4	(10.2)	10.4	(7.8)	5.4	(5.2)
Avg. # times you test per week	9.0	(8.6)	13.7	(10.8)	9.4	(8.3)	4.6	(4.6)
# Last seven days tested	4.6	(2.6)	5.2	(2.6)	5.0	(2.5)	3.4	(2.5)
# Tests done in the last week	8.7	(8.4)	13.4	(10.5)	9.0	(8.1)	4.5	(5.3)
# Planned breaks in past month	6.1	(7.8)	8.1	(7.9)	6.3	(8.7)	3.7	(4.4)
# Times skipped in past month	5.5	(10.4)	8.3	(13.2)	4.8	(9.5)	4.6	(8.0)

Table 6 ***Health Status Variables Specific to Insulin Across the Whole Sample and by Type of Diabetes***

HEALTH STATUS: Insulin	Total		Type I		Type II, Insulin		Type II, No Insulin	
	N	(%)	N	(%)	N	(%)	N	(%)
Insulin at diagnosis								
Yes	784	(39.0)	258	(100.0)	498	(48.5)	8	(1.4)
No	1228	(61.0)	-----	---	528	(51.5)	557	(98.6)
Take insulin now								
Yes	1390	(67.6)	258	(100.0)	1049	(100.0)	-----	-----
No	621	(30.2)	-----	-----	-----	-----	568	(100.0)
How do you take your insulin?								
Pump	8	(0.6)	3	(1.2)	4	(0.4)	-----	-----
Injections	1336	(99.4)	249	(98.8)	1012	(99.6)	-----	-----
# Times skipped for 1 day or more in the last year								
Never	1126	(82.0)	223	(87.1)	838	(81.0)	-----	-----
1-5 times	190	(13.8)	26	(10.2)	151	(14.6)	-----	-----
6-10 times	25	(1.8)	6	(2.3)	19	(1.8)	-----	-----
11-20 times	16	(1.2)	-----	-----	14	(1.4)	-----	-----
21 or more times	16	(1.2)	1	(0.4)	13	(1.3)	-----	-----
	M	**(SD)**	**M**	**(SD)**	**M**	**(SD)**	**M**	**(SD)**
# Times told to take insulin per week	23.2	(58.0)	26.9	(36.9)	22.7	(64.0)	-----	-----
# Insulin shots in last week	12.6	(6.1)	14.8	(7.1)	12.1	(5.6)	-----	-----
# Times skipped in past month	0.6	(3.0)	0.8	(5.8)	0.5	(1.4)	-----	-----

Table 7 ***Health Status Variables Specific to Oral Diabetes Medication Across the Whole Sample and by Type of Diabetes***

HEALTH STATUS: Pills	Total		Type I		Type II, Insulin		Type II, No Insulin	
	N	(%)	N	(%)	N	(%)	N	(%)
Take pills now								
Yes	828	(42.4)	10	(3.9)	283	(28.6)	479	(84.3)
No	1126	(57.6)	245	(96.1)	708	(71.4)	89	(15.7)
	M	**(SD)**	**M**	**(SD)**	**M**	**(SD)**	**M**	**(SD)**
# Times told to take pills per week	39.4	(112.8)	22.8	(33.4)	31.7	(90.9)	44.8	(126.2)
# Pills in the last week	13.3	(10.3)	12.8	(12.8)	12.2	(9.9)	13.8	(10.4)
# Times skipped in past month	1.2	(5.4)	0.8	(1.3)	1.0	(3.4)	1.3	(6.2)
# Times skipped in past year	3.3	(11.8)	1.2	(1.9)	2.9	(11.6)	3.4	(12.2)

Table 8 ***Fit Indices for Glucose Testing Decisional Balance: Exploratory CFAs Run on the First Half of the Sample (n=597); Confirmatory CFA Run on the Second Half of the Sample(n=607)***

	Null Model	One Factor Model	Random Two Factor Correlated Model*	Two Factor Uncorr. Model	Two Factor Correlated Model	Confirmatory Sample Two Factor Correlated Model
χ^2	2998.30	1067.24	----.--	164.71	157.57	227.73
df	66	54	----	54	53	53
p	<.001	<.001	----	<.001	<.001	<.001
GFI	.435	.683	.----	.956	.958	.941
CFI		.654	.----	.962	.964	.940
RMSR	.316	.183	.----	.065	.056	.057
Alpha		.7621				
Pros			.-----	.9080	.9080	.8894
Cons			.-----	.8060	.8060	.8059

***did not converge**

Table 9 ***Factor Loadings for Glucose Testing Decisional Balance: Exploratory CFAs Run on the First Half of the Sample (n=597); Confirmatory CFA Run on the Second Half of the Sample(n=607)***

	Null Model	One Factor Model	Random Two Factor Correlated Model*	Two Factor Uncorr. Model	Two Factor Correlated Model	Confirmatory Sample Two Factor Correlated Model
Pros of Glucose Testing						
1	.-----	838	Factor 1	.837	.838	.745
7	.-----	.822	Factor 1	.823	.823	.798
9	.-----	.760	Factor 2	.763	.762	.723
13	.-----	.683	Factor 1	.682	.682	.709
21	.-----	.754	Factor 2	.755	.755	.738
26	.-----	.875	Factor 2	.874	.874	.833
Cons of Glucose Testing						
4	.-----	-.154	Factor 1	.725	727	.681
8	.-----	-.197	Factor 2	.795	.800	.771
10	.-----	-.017	Factor 1	.652	.649	.628
12	.-----	.072	Factor 1	.610	.604	.633
14	.-----	-.080	Factor 2	.529	.528	.592
24	.-----	-.071	Factor 2	.521	.520	.531

***did not converge**

Table 10 ***Chi-Square Difference Tests Between the Two Factor Correlated Model for Glucose Testing Decisional Balance and Each Comparison Model***

Model	χ^2 Difference	*df* Difference	p
Null	2840.73	13	<.001
One Factor	909.67	1	<.001
Two Factor, Uncorrelated	7.14	1	<.01

Table 11 ***Fit Indices for the Final Two Factor Correlated Model for Glucose Testing Decisional Balance Run on the Overall Sample and then on Different Sub-Samples***

	Entire Sample	Type I ss	Type II ss, on insulin	Type II ss, no insulin	All ss on insulin	All Type II ss
N	1186	202	723	189	925	912
χ^2	340.89	131.90	224.91	142.27	271.81	291.52
df	53	53	53	53	53	53
p	<.001	<.001	<.001	<.001	<.001	<.001
GFI	.954	.904	.950	.893	.953	.949
CFI	.953	.930	.953	.897	.954	.947
RMSR	.054	.078	.057	.075	.056	.055
Alpha						
Pros	.8993	.9052	.8983	.8892	.9006	.8980
Cons	.8056	.8125	.8087	.7319	.8099	.7966

Table 12 *Factor Loadings for the Final Two Factor Correlated Model for Glucose Testing Decisional Balance Run on the Overall Sample and then on Different Sub-Samples*

	Entire Sample	Type I ss	Type II ss, on insulin	Type II ss, no insulin	All ss on insulin	All Type II ss
Pros of Glucose Testing						
1	.795	.803	.786	.789	.789	.792
7	.811	.855	.787	.811	.810	.794
9	.743	.776	.741	.735	.755	.740
13	.694	.679	.692	.688	.688	.695
21	.746	.776	.757	.683	.762	.743
26	.855	.818	.868	.837	.853	.865
Cons of Glucose Testing						
4	.703	.764	.702	.596	.718	.687
8	.785	.843	.744	.897	.771	.762
10	.638	.601	.660	.580	.638	.642
12	.618	.640	.641	.407	.637	.601
14	.560	.510	.554	.521	.549	.554
24	.525	.511	.555	.308	.550	.521

Table 13 ***Stage Distributions Using the One-Item Algorithm for All Three Behaviors Across the Whole Sample and by Type of Diabetes***

	Total		Type I		Type II, Insulin		Type II, No Insulin	
	N	(%)	N	(%)	N	(%)	N	(%)
Glucose Testing Stage								
Precontemplation	73	(4.9)	19	(8.4)	33	(3.8)	16	(5.6)
Contemplation	69	(4.7)	11	(4.9)	38	(4.4)	12	(4.2)
Preparation	130	(8.8)	20	(8.9)	59	(6.8)	37	(12.9)
Action	85	(5.8)	6	(2.7)	39	(4.5)	33	(11.5)
Maintenance	870	(58.9)	117	(52.0)	544	(63.1)	156	(54.4)
Don't Know Standard	249	(16.9)	52	(23.1)	149	(17.3)	33	(11.5)
Total	1404		225		862		287	
Medication Stage-- Overall								
Precontemplation	24	(1.4)	3	(1.3)	3	(0.9)	7	(1.6)
Contemplation	4	(0.2)	2	(0.8)	1	(0.1)	1	(0.2)
Preparation	18	(1.0)	1	(0.4)	6	(0.6)	10	(2.3)
Action	54	(3.1)	1	(0.4)	33	(3.5)	15	(3.4)
Maintenance	1122	(64.8)	85	(35.4)	606	(63.7)	363	(82.9)
Don't Know Standard	510	(29.4)	148	(61.7)	296	(31.1)	42	(9.6)
Total	1732		240		951		438	
Medication Stage-- Insulin								
Precontemplation	14	(1.1)	3	(1.3)	9	(0.9)	-----	-----
Contemplation	3	(0.2)	2	(0.8)	1	(0.1)	-----	-----
Preparation	6	(0.5)	1	(0.4)	5	(0.5)	-----	-----
Action	35	(2.9)	1	(0.4)	33	(3.6)	-----	-----
Maintenance	718	(60.9)	85	(35.4)	591	(65.9)	-----	-----
Don't Know Standard	459	(34.5)	148	(61.7)	291	(29.0)	-----	-----
Total	1235		240		930		-----	-----
Medication Stage-- Pills								
Precontemplation	29	(4.1)	-----	-----	18	(9.7)	7	(1.5)
Contemplation	2	(0.3)	-----	-----	1	(0.5)	1	(0.2)
Preparation	12	(1.7)	-----	-----	1	(0.5)	10	(2.2)
Action	27	(4.9)	-----	-----	7	(6.5)	15	(3.5)
Maintenance	524	(78.9)	-----	-----	126	(71.0)	363	(83.4)
Don't Know Standard	71	(10.1)	-----	-----	22	(11.8)	42	(9.2)
Total	665		-----		175		438	

Table 14 ***Classification Results of a DFA Run on Those Staged from PC to Maintenance (n=338) in order to Place Doctor's Standard Group (n=682) and Don't Know Standard Group (n=209) into a Four-Stage Model***

		Predicted Group Membership				
	N	**PC**	**C**	**P**	**A**	**M**
Glucose Testing Stage of Change						
Precont.	60	38	9	5	3	5
		63.3%	15.0%	8.3%	5.0%	8.3%
Cont.	60	16	21	10	11	2
		26.7%	35.0%	16.7%	18.3%	3.3%
Prep.	114	30	27	21	23	13
		26.3%	23.7%	18.4%	20.2%	11.4%
Action.	70	9	5	10	16	30
		12.9%	7.1%	14.3%	22.9%	42.9%
Maintenance	726	39	47	40	131	469
		5.4%	8.0%	4.3%	18.1%	64.6%
Don't Know Standard	220	21	28	41	47	83
		9.5%	12.7%	18.6%	21.4%	37.7%

Table 15 ***The Pros and Cons of Glucose Testing By Stage of Glucose Testing, Gender, and Type of Diabetes***

	Pros of Glucose Testing			Cons of Glucose Testing		
	N	**M**	**(SD)**	**N**	**M**	**(SD)**
Stage of Change	$F_{(4, 1018)}=88.792^{***}$, $\eta^2=.259$			$F_{(4, 1018)}=47.241^{***}$, $\eta^2=.157$		
Precontemplation	60	33.4^{a}	(12.6)	60	54.5^{a}	(11.0)
Contemplation	60	43.6^{b}	(10.5)	60	58.3^{a}	(9.9)
Preparation	114	44.5^{b}	(10.2)	114	57.1^{a}	(8.5)
Action	70	49.2^{c}	(10.2)	70	51.0^{b}	(9.3)
Maintenance	724	52.9^{d}	(8.0)	724	47.2^{c}	(9.2)
Gender	$F_{(1, 1018)}=8.642^{**}$, $\eta^2=.007$			$F_{(1, 1018)}=4.453^{*}$, $\eta^2=.004$		
Male	408	48.7^{a}	(11.1)	408	48.7^{a}	(9.9)
Female	620	51.0^{b}	(9.7)	620	50.3^{b}	(10.2)
Type of Diabetes	$F_{(2,953)}=0.021^{NS}$			$F_{(2,953)}=6.115^{**}$, $\eta^2=.013$		
Type I	162	48.7	(11.9)	162	51.4^{a}	(10.4)
Type II, Insulin	606	51.1	(9.9)	606	49.0^{bc}	(10.1)
Type II, No Insulin	197	48.2	(10.3)	197	49.1^{ac}	(9.1)

^{NS} not significant
* $p<.05$
** $p<.01$
*** $p<.001$

Table 16 ***Fit Indices for Medication Decisional Balance: Exploratory CFAs Run on the First Half of the Sample (n=784); Confirmatory CFA Run on the Second Half of the Sample(n=789)***

	Null Model	One Factor Model	Random Two Factor Correlated Model	Two Factor Uncorr. Model	Two Factor Correlated Model	Confirmatory Sample Two Factor Correlated Model
χ^2	3340.34	1499.48	1490.30	206.99	202.51	154.97
df	66	54	53	54	53	53
p	.001	<.001	<.001	<.001	<.001	<.001
GFI	.472	.676	.677	.958	.959	.967
CFI		.559	.561	.953	.954	.967
RMSR	.294	.186	.186	.048	.040	.040
Alpha	.-----	.7384	.-----	.-----	.-----	.-----
Pros	.-----	.-----	.5463	.8601	.8601	.8345
Cons	.-----	.-----	.5543	.8099	.8099	.8165

Table 17 *Factor Loadings for Medication Decisional Balance: Exploratory CFAs Run on the First Half of the Sample (n=784); Confirmatory CFA Run on the Second Half of the Sample(n=789)*

	Null Model	One Factor Model	Random Two Factor Correlated Model	Two Factor Uncorr. Model	Two Factor Correlated Model	Confirmatory Sample Two Factor Correlated Model
Pros of Glucose Testing						
1	.-----	.704	.712	.701	.702	.638
7	.-----	.669	.679	.670	.670	.675
11	.-----	.679	.689	.683	.682	.668
13	.-----	.812	.820	.815	.814	.807
15	.-----	.722	.738	.722	.722	.729
17	.-----	.679	.699	.677	.678	.647
Cons of Glucose Testing						
2	.-----	-.096	-.099	.701	.702	.708
4	.-----	.039	.045	.511	.509	.548
6	.-----	-.132	-.131	.776	.777	.766
8	.-----	-.068	-.087	.620	.620	.632
10	.-----	-.067	-.058	.722	.721	.726
12	.-----	-.095	-.097	.540	.540	.523

Table 18 ***Chi-Square Difference Tests Between the Two Factor Correlated Model for Medication Decisional Balance and Each Comparison Model***

Comparison Models	χ^2 Difference	*df* Difference	p
Null	3137.83	13	<.001
One Factor	1296.97	1	<.001
Two Factor, Uncorrelated	4.48	1	<.05

Table 19 *Fit Indices for Final Two Factor Correlated Model for Medication Decisional Balance Run on the Overall Sample and then on Different Sub-Samples*

	Entire Sample	Type I ss	Type II ss, on insulin	Type II ss, no insulin	All ss on insulin	All Type II
N	1573	234	855	388	1089	1243
χ^2	309.15	118.87	196.30	123.10	213.40	260.82
df	53	53	53	53	53	53
p	<.001	<.001	<.001	<.001	<.001	<.001
GFI	.967	.920	.962	.948	.967	.965
CFI	.959	.936	.959	.951	.964	.958
RMSR	.040	.052	.046	.050	.041	.043
Alpha	.-----	.-----	.-----	.-----	.-----	.-----
Pros	.8479	.8796	.8430	.8375	.8531	.8421
Cons	.8138	.7896	.8212	.7998	.8146	.8158

Table 20 *Factor Loadings for Final Two Factor Correlated Model for Medication Decisional Balance Run on the Overall Sample and then on Different Sub-Samples*

	Entire Sample	Type I ss	Type II ss, on insulin	Type II ss, no insulin	All ss on insulin	All Type II ss
Pros of Medication						
1	.638	.692	.605	.637	.628	.620
7	.675	.736	.643	.648	.671	.649
11	.668	.757	.674	.637	.685	.664
13	.807	.858	.805	.787	.821	.799
15	.729	.774	.730	.727	.745	.724
17	.647	.634	.667	.641	.658	.659
Cons of Medication						
2	.708	.620	.722	.695	.707	.715
4	.548	.621	.553	.496	.561	.539
6	.766	.715	.791	.713	.778	.771
8	.632	.590	.637	.653	.631	.639
10	.726	.660	.737	.722	.721	.737
12	.523	.520	.522	.526	.513	.519

Table 21 ***The Pros and Cons of Medication By Stage of Medication, Gender, and Stage by Type of Diabetes***

	Pros of Medication			Cons of Medication		
	N	**M**	**(SD)**	**N**	**M**	**(SD)**
Stage of Change	$F_{(4, 1484)}=14.165^{***}$, $\eta^2=.037$			$F_{(4, 1484)}=6.993^{***}$, $\eta^2=.019$		
Precontemplation	12	33.2^{a}	(17.8)	12	59.9^{a}	(13.4)
Cont./Prep.	19	39.7^{a}	(15.9)	19	56.2^{a}	(10.2)
Action	51	49.1^{b}	(8.5)	51	52.2^{ab}	(11.0)
Maintenance	966	50.2^{b}	(9.6)	966	45.5^{b}	(9.5)
Gender	$F_{(1, 1040)}=0.102^{NS}$			$F_{(1, 1040)}=1.702^{NS}$		
Male	600	48.7	(11.1)	600	49.3	(9.7)
Female	894	50.6	(9.0)	894	50.4	(10.0)
Stage by Type of Diabetes	$F_{(8,1394)}=4.958^{***}$, $\eta^2=.028$			$F_{(8,1394)}=0.984^{NS}$		
PC/Type I	3	45.2	(10.6)	3	54.1	(16.2)
PC/Type II, Insulin	7	33.7	(16.0)	7	59.3	(12.6)
PC/Type II, No Insulin	1	-2.2	(0)	1	79.4	(0)
C&P/Type I	3	55.4	(5.9)	3	57.2	(8.5)
C&P/Type II, Insulin	5	45.6	(11.8)	5	61.2	(13.2)
C&P/Type II, No Insulin	10	30.1	(13.7)	10	54.0	(9.4)
A/Type I	1	28.3	(0)	1	47.9	(0)
A/Type II, Insulin	31	50.2	(6.8)	31	53.4	(10.9)
A/Type II, No Insulin	14	48.3	(10.5)	14	51.2	(11.8)
M/Type I	79	49.5	(10.0)	79	49.4	(8.7)
M/Type II, Insulin	517	51.0	(9.3)	517	50.2	(10.1)
M/Type II, No Insulin	314	49.3	(10.0)	314	48.6	(9.0)
DK/Type I	134	49.6	(10.8)	134	48.3	(8.4)
DK/Type II, Insulin	252	51.0	(9.0)	252	50.9	(10.4)
DK/Type II, No Insulin	38	48.2	(10.7)	38	49.6	(10.5)

^{NS} not significant
* $p<.05$
** $p<.01$
*** $p<.001$

Figure 1. **Two factor correlated CFA for glucose testing decisional balance on exploratory sample (n=579).**

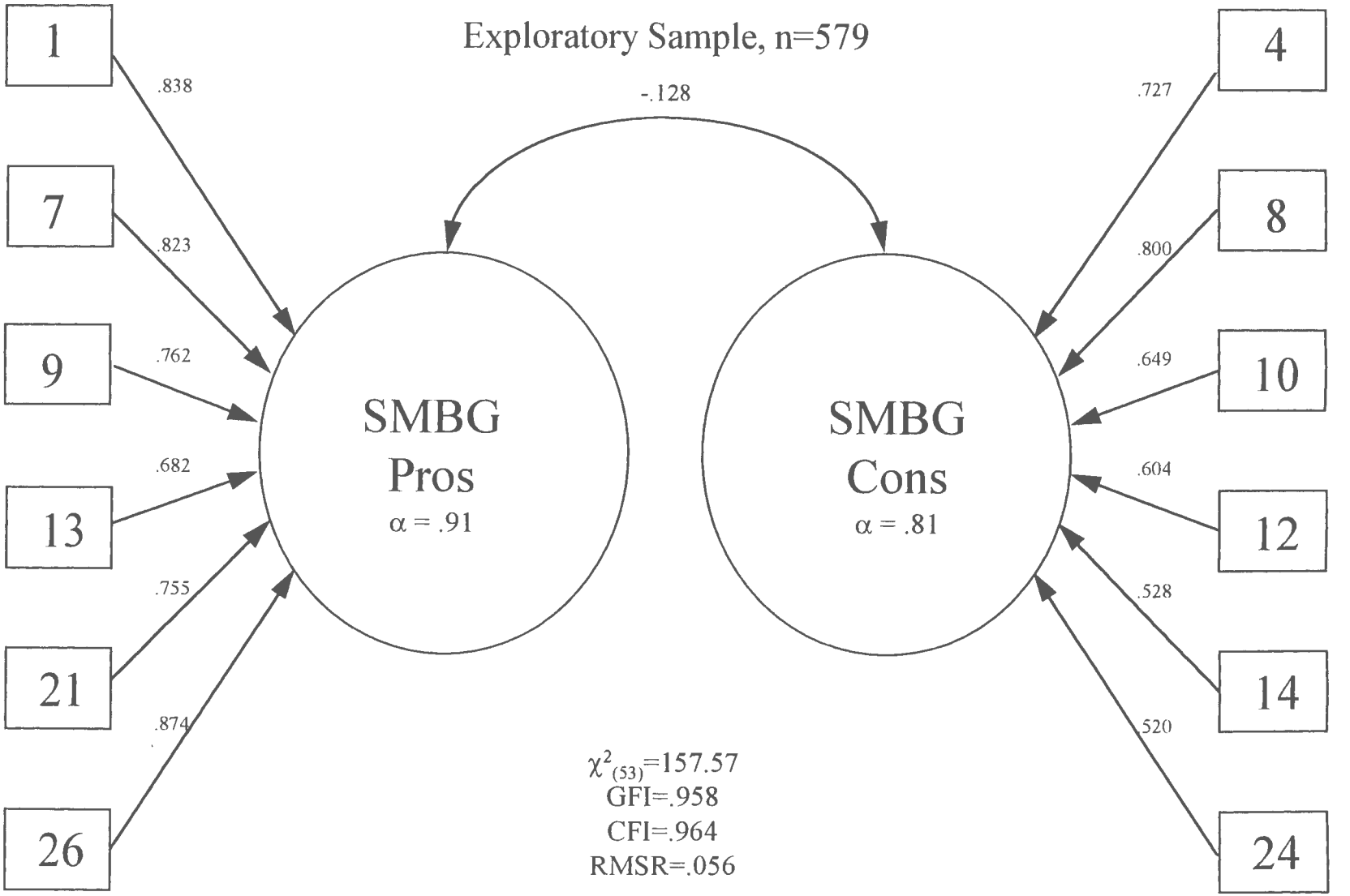

Exploratory Sample, n=579
1
7
9
13
21
26
4
8
10
12
14
24
.838
.823
.762
.682
.755
.874
.727
.800
.649
.604
.528
.520
-.128
SMBG
Pros
α = .91
SMBG
Cons
α = .81
$\chi^2_{(53)}$=157.57
GFI=.958
CFI=.964
RMSR=.056

Figure 2. **Two factor correlated CFA for glucose testing decisional balance on confirmatory sample (n=607).**

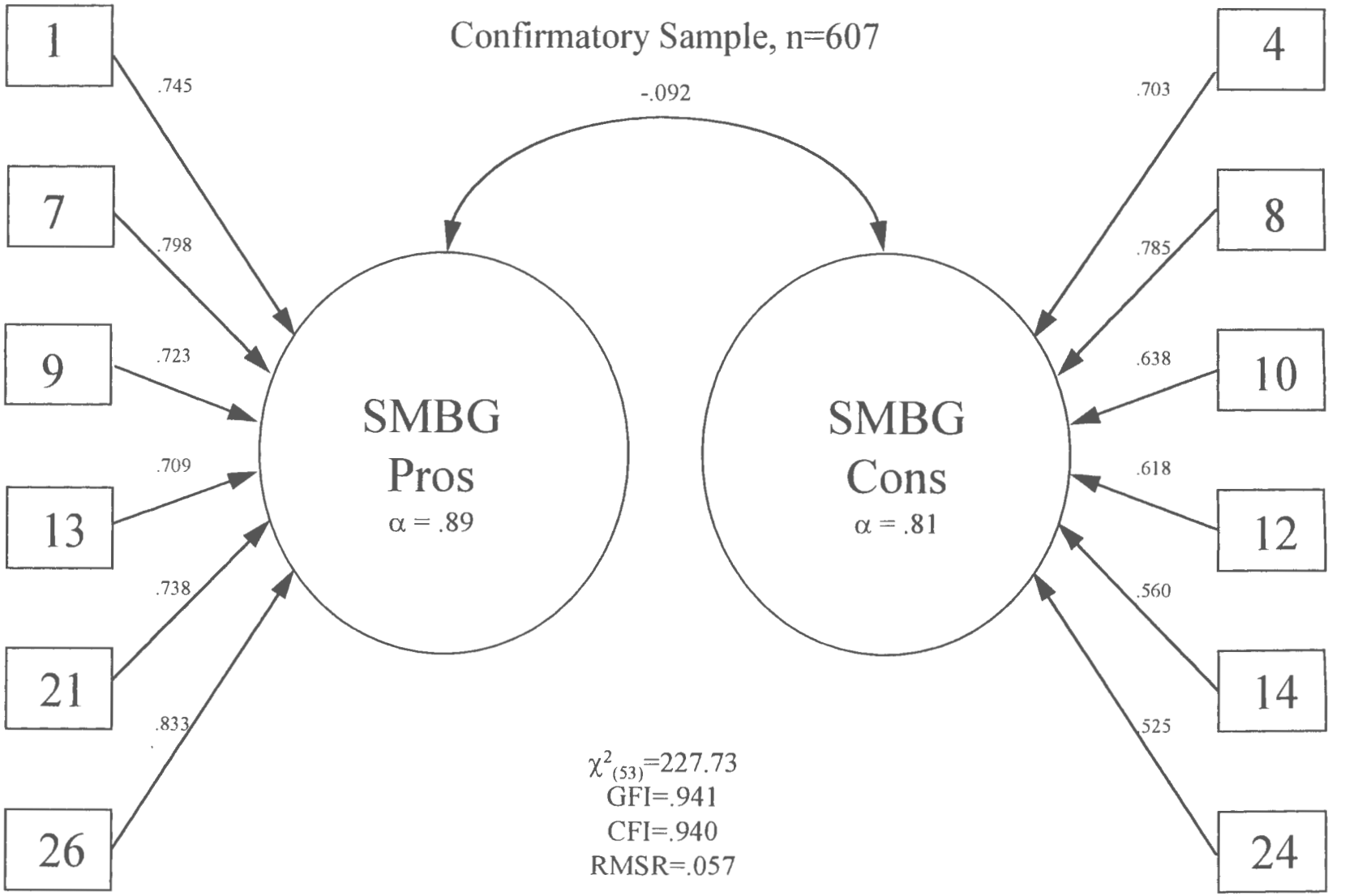

Confirmatory Sample, n=607
1
7
9
13
21
26
4
8
10
12
14
24
.745
.798
.723
.709
.738
.833
.703
.785
.638
.618
.560
.525
-.092
SMBG
Pros
α = .89
SMBG
Cons
α = .81
χ²(53)=227.73
GFI=.941
CFI=.940
RMSR=.057

Figure 3. **Glucose testing decisional balance by stage of change for glucose testing, whole sample (N=1055).**

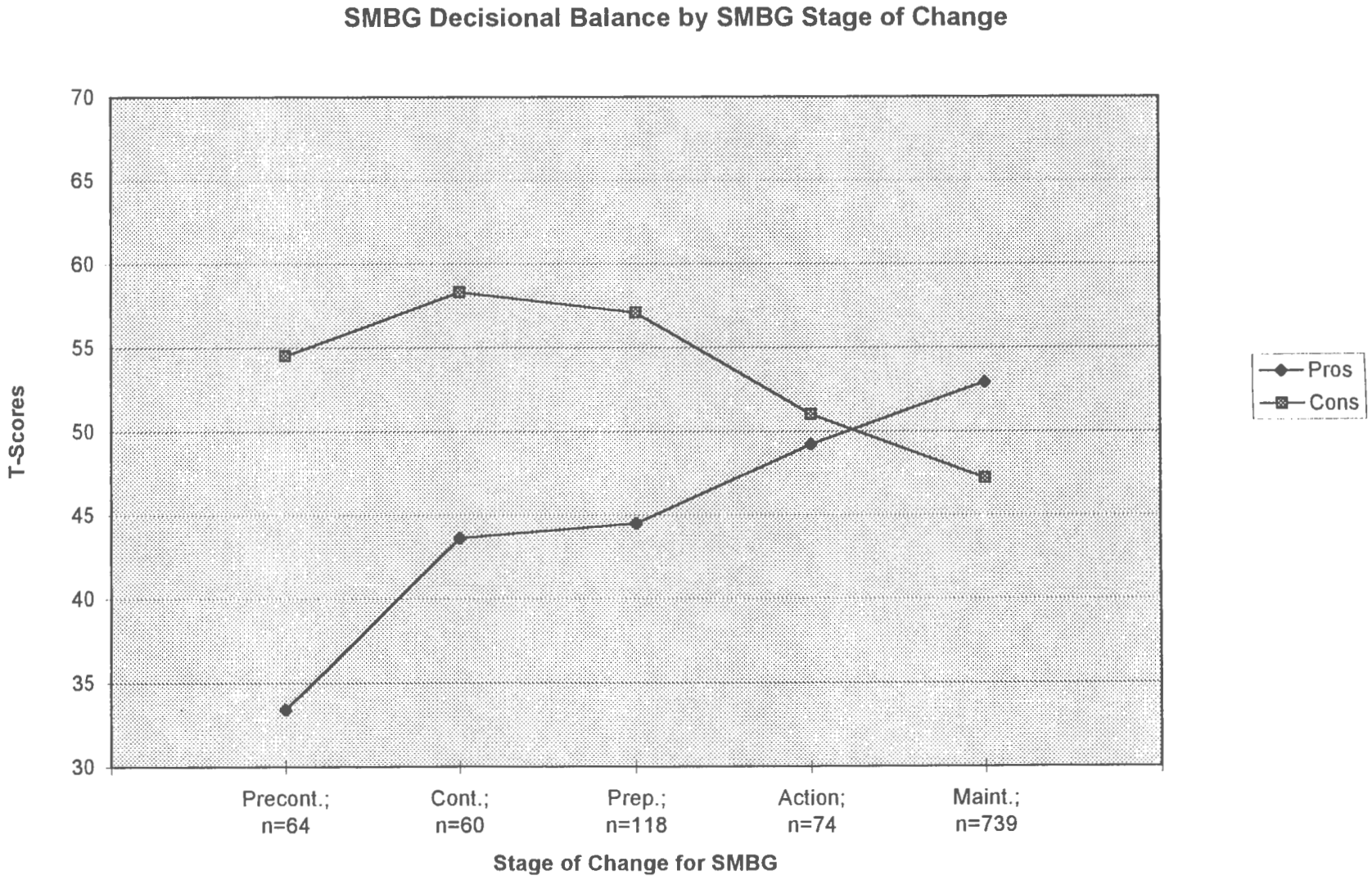

SMBG Decisional Balance by SMBG Stage of Change
T-Scores
70
65
60
55
50
45
40
35
30
Precont.; n=64
Cont.; n=60
Prep.; n=118
Action; n=74
Maint.; n=739
Stage of Change for SMBG
Pros
Cons

Figure 4. **Glucose testing decisional balance by gender; whole sample (N=1055).**

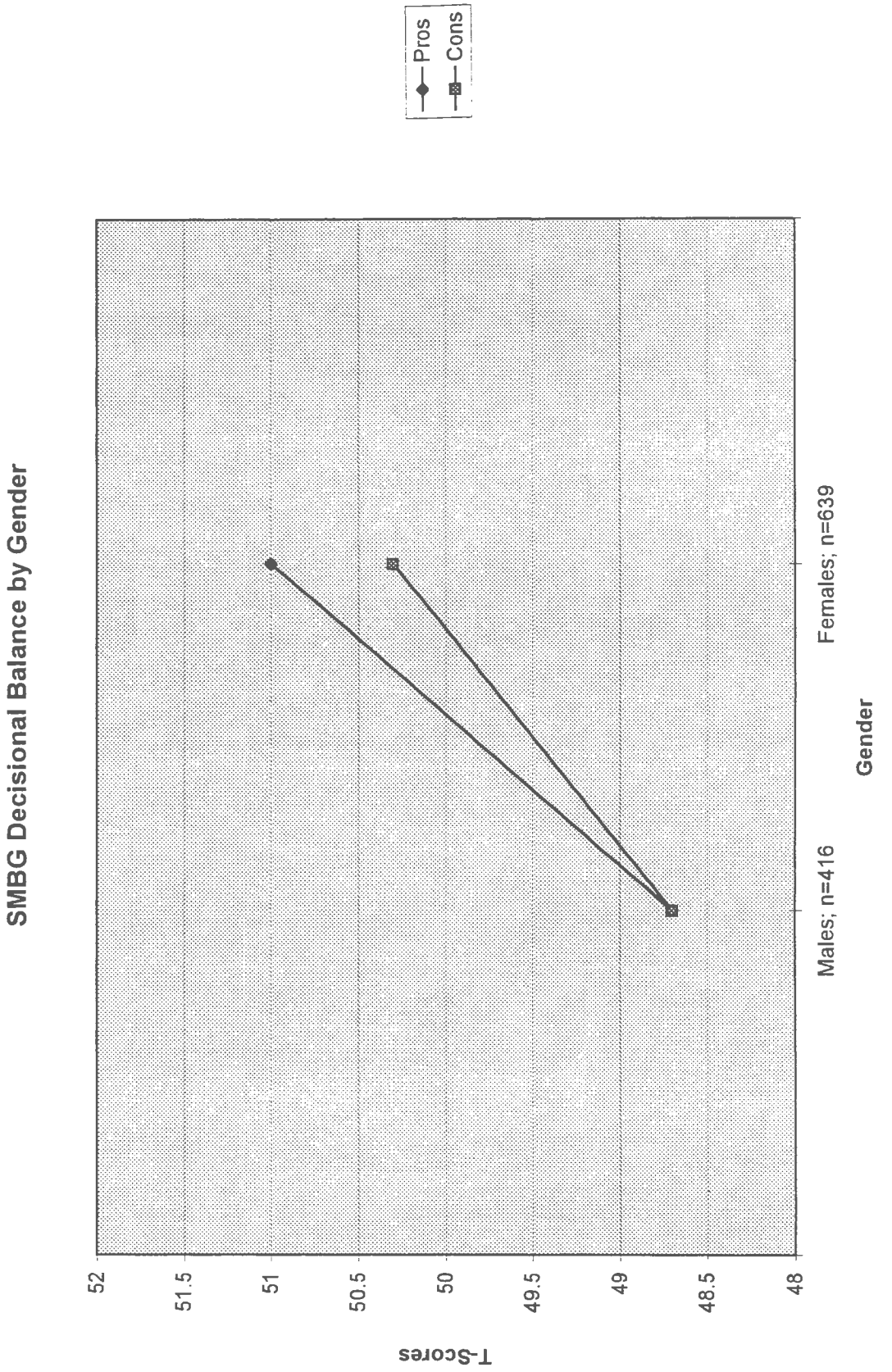

SMBG Decisional Balance by Gender
Pros
Cons
T-Scores
52
51.5
51
50.5
50
49.5
49
48.5
48
Males; n=416
Females; n=639
Gender

Figure 5. **Glucose testing decisional balance by type of diabetes; whole sample (N=992).**

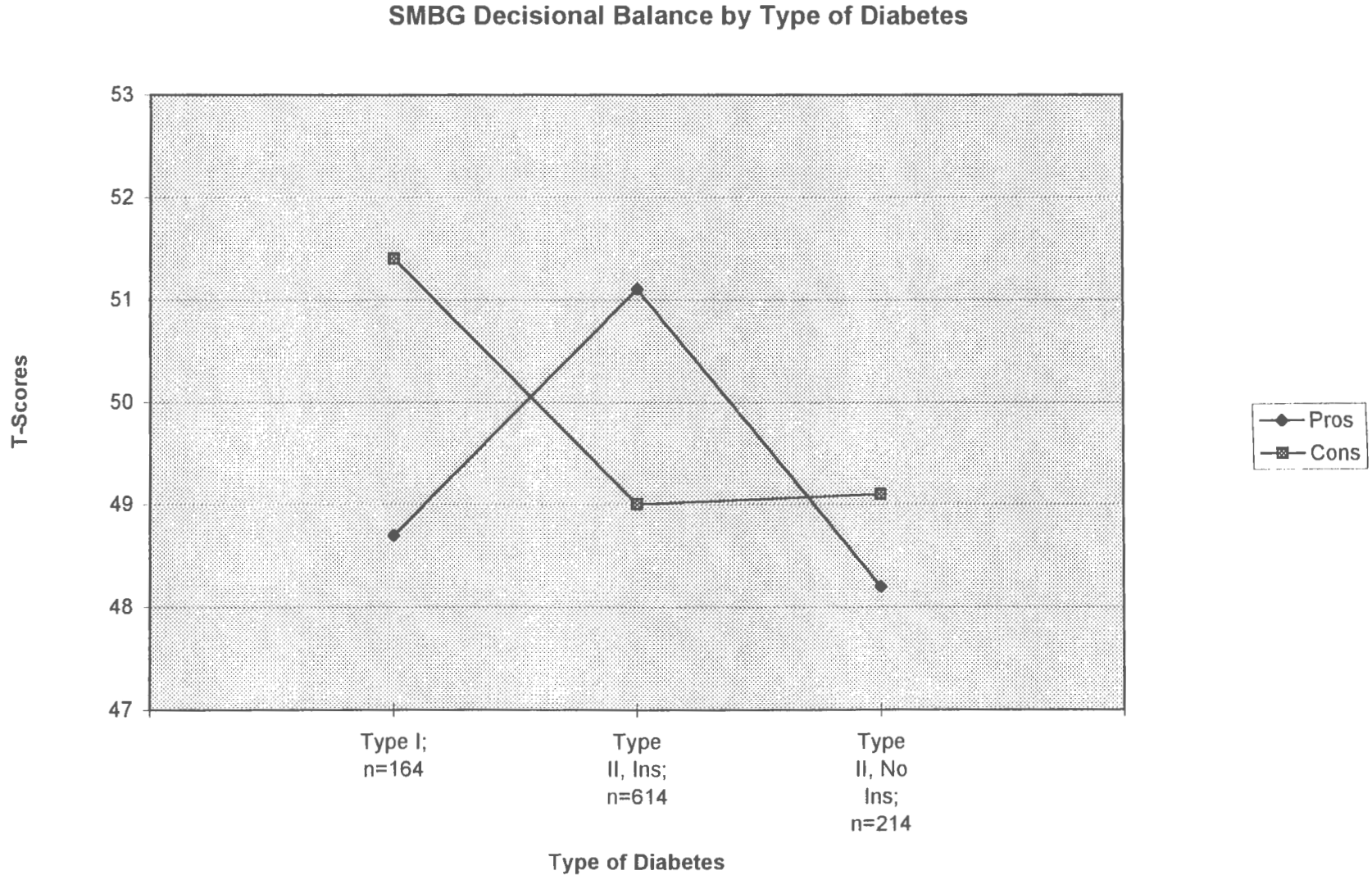

SMBG Decisional Balance by Type of Diabetes
T-Scores
53
52
51
50
49
48
47
Type I; n=164
Type II, Ins; n=614
Type II, No Ins; n=214
Type of Diabetes
Pros
Cons

Figure 6. **Two factor correlated CFA for medication decisional balance on exploratory sample (n=784).**

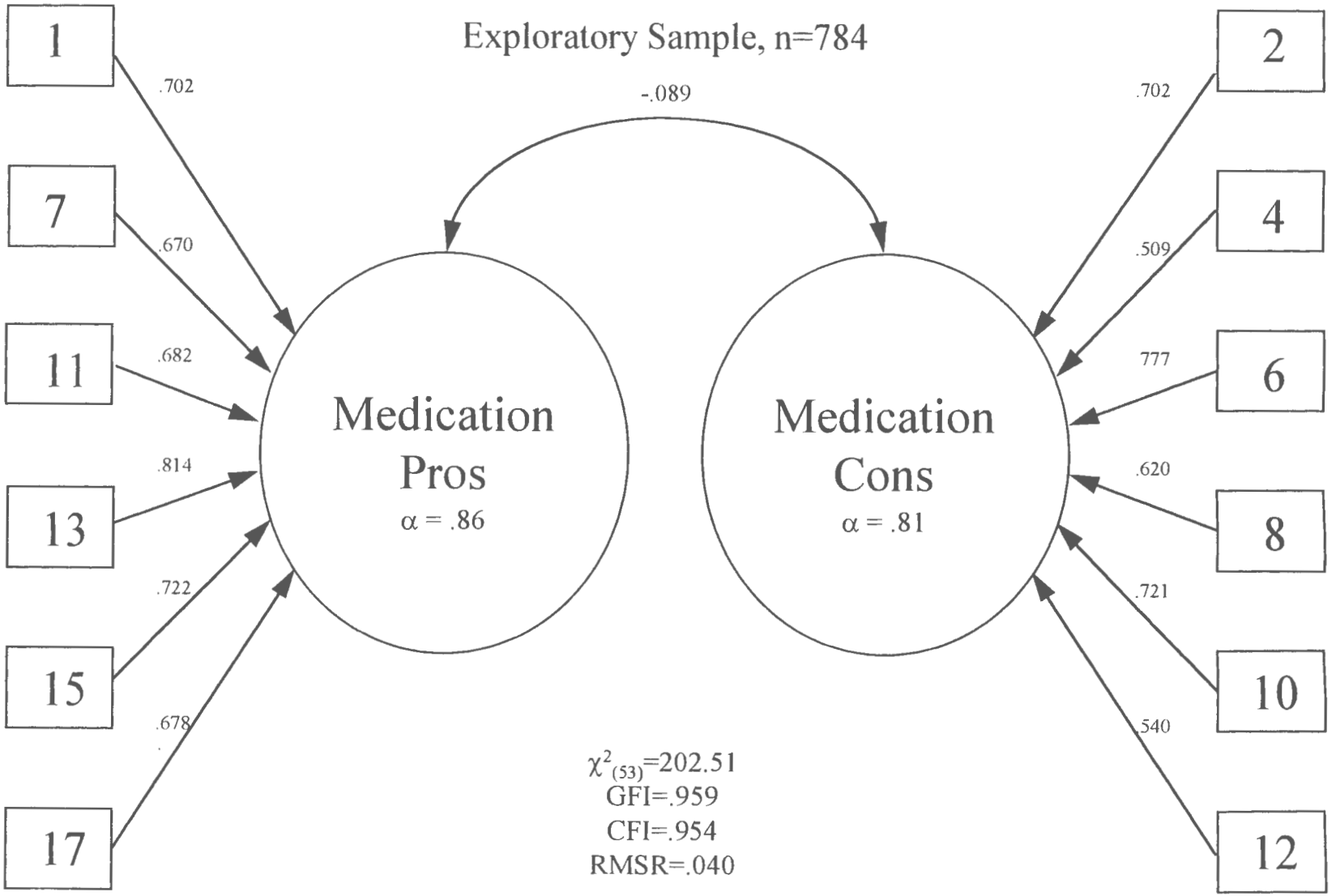

Exploratory Sample, n=784
1
7
11
13
15
17
.702
.670
.682
.814
.722
.678
-.089
Medication Pros
α = .86
Medication Cons
α = .81
.702
.509
.777
.620
.721
.540
2
4
6
8
10
12
$\chi^2_{(53)}$=202.51
GFI=.959
CFI=.954
RMSR=.040

Figure 7. **Two factor correlated CFA for medication decisional balance on confirmatory sample (n=789).**

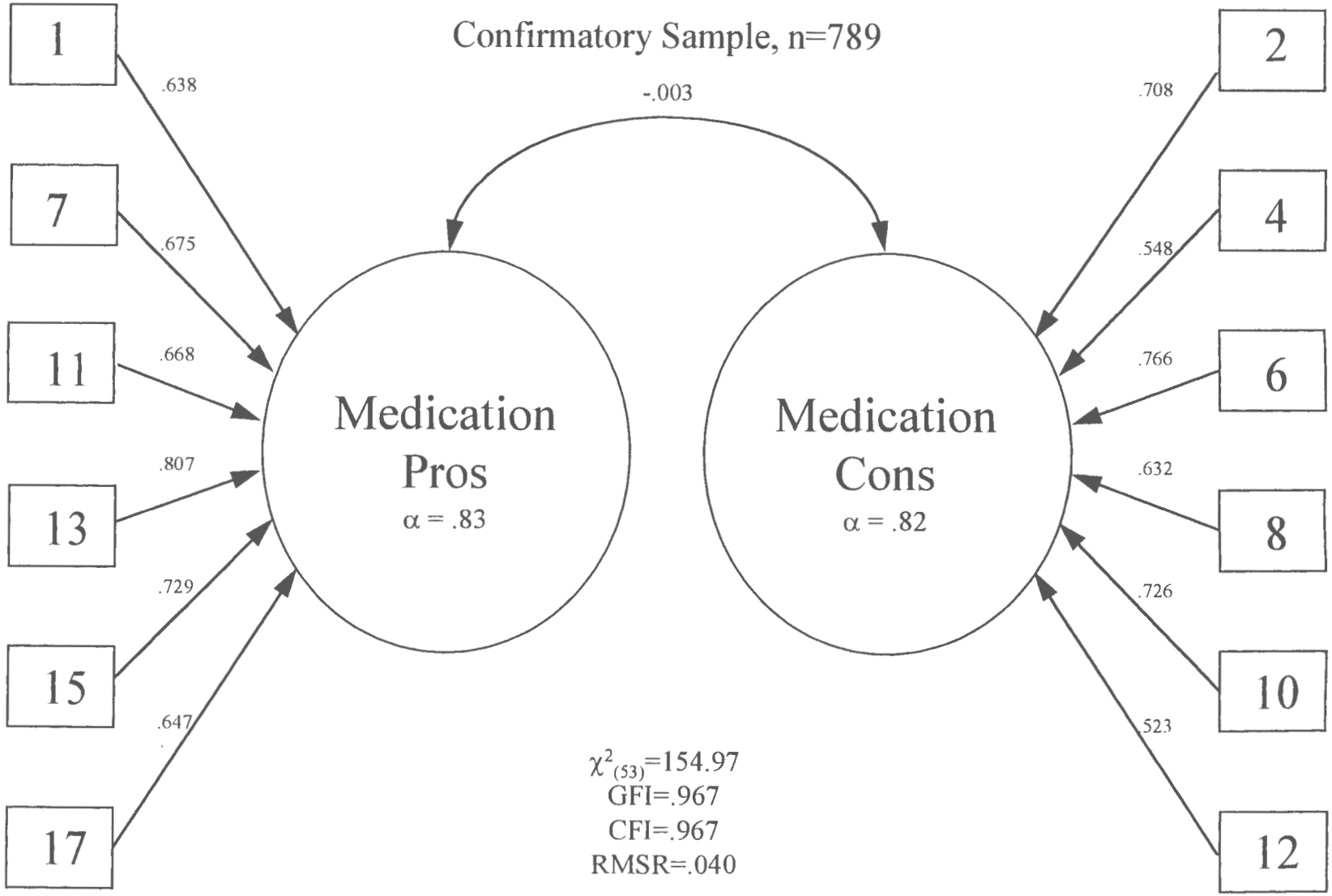

Confirmatory Sample, n=789
1
7
11
13
15
17
.638
.675
.668
.807
.729
.647
-.003
Medication Pros
α = .83
Medication Cons
α = .82
.708
.548
.766
.632
.726
.523
2
4
6
8
10
12
$\chi^2_{(53)}$=154.97
GFI=.967
CFI=.967
RMSR=.040

Figure 8. **Medication decisional balance by stage of change for medication; whole sample (N=1048).**

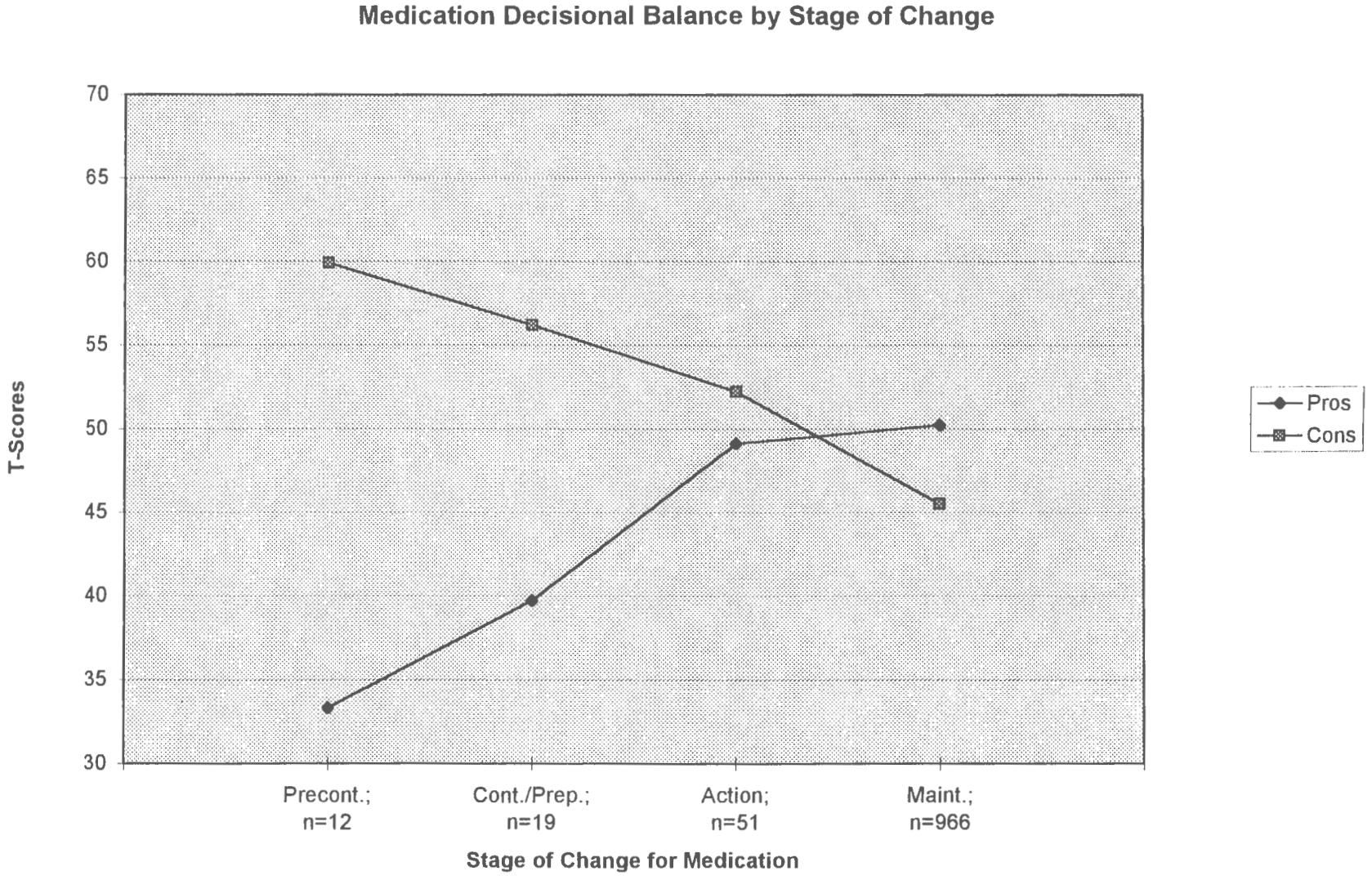
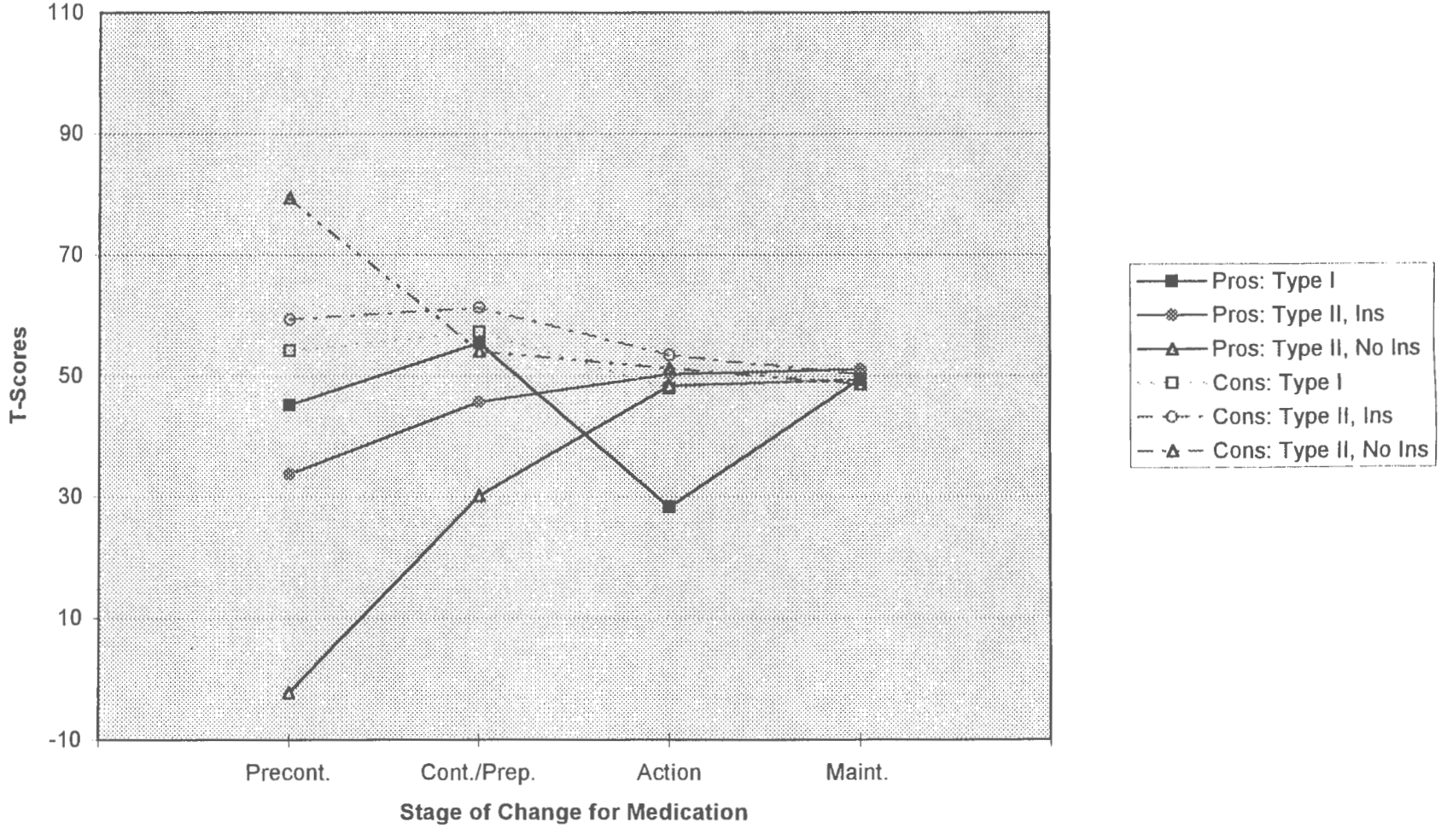

Medication Decisional Balance by Stage of Change
T-Scores
70
65
60
55
50
45
40
35
30
Precont.; n=12
Cont./Prep.; n=19
Action; n=51
Maint.; n=966
Stage of Change for Medication
Pros
Cons

Figure 9. **Medication decisional balance by stage of change for medication and type of diabetes; whole sample (N=985).**

Medication Decisional Balance by Stage of Change for Medication and Type of Diabetes



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